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Line and Generator Switching at Niagara Falls

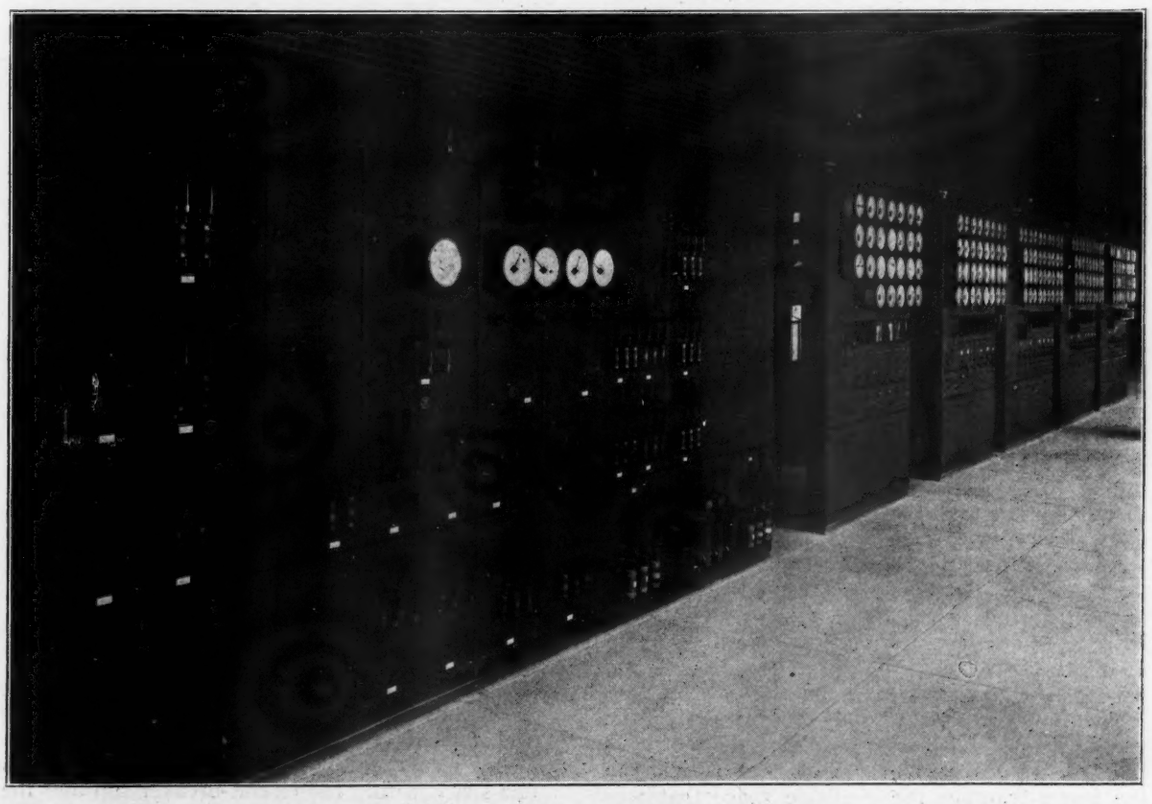
Main Connections of Generating Equipment Made in Substation Separate from Generator House—Switchboard Provided for Each Unit—Circuit-Breakers Built for Severe Operating Conditions

By STEPHEN Q. HAYES

At the top of the cliff above the generating station of the Niagara Falls Power Co. is located a switch house containing three 2000-ampere, CO-2 circuit-breakers connected in the three main circuits from the new 32,500-kw. units. These type CO-2 circuit-breakers, utilized here and also at the Echota substation, have been supplied for this project in 2000-ampere capacity for generator and main-line bus circuits and in 800-ampere capacity for use on various feeder circuits at Echota.

Accompanying illustrations show the front and rear views of a 2000-ampere circuit-breaker before being assembled in its masonry compartment. In the front view the circuit-breaker is shown with the operating mechanism and the brushes in the closed position, while in the rear view it is shown in the open position. The tank has been dropped on one pole to show more clearly the arrangement of the contacts.

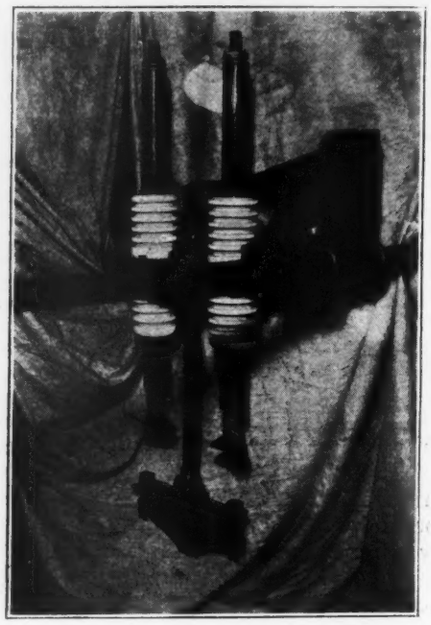
Among the important features of these circuit-breakers are the efficient self-cleaning form of main contacts protected by extra-heavy, high-speed arcing contacts, permanent submersion and opening of all contacts under a large head of oil, fast closing speed for synchronizing purposes, rapid opening of all contacts assisted by heavy accelerating springs, open position maintained by



Switchboard in Main Control Room at Echoto Substation—Local-Service Panels at Left.

gravity and completely insulated leads extending into the disconnecting switch structure.

Mechanical separation of leads from the operating mechanism in front of the circuit-breaker is secured by means of the steel compartment plates. The strong cylindrical die-pressed steel tanks are held securely in place by steel tank supports, the tanks being thoroughly grounded. Tanks are removable without disturbing the operating mechanism or contacts, making inspection easy, and individual tanks inclose the contacts on each pole of the circuit-breaker. Ample air space at the top of the tank provides the desired cushioning effect for gas expansion, and two check valves on the tanks facilitate air circulation and prevent oil throwing. There are double sets of insulating linings in each tank. This equipment is provided with unit-type electric operating mechanism having closing, accelerating, tripping and shock-absorbing features and is self contained. It is impossible to hold the contacts in the closed position with an excessive overload or short-circuit existing on the lines. Being self contained, these circuit-breakers require no intermediate walls in the cell structure for supporting individual poles, thus reducing the expense of the cell structure to a minimum. The operating mechanism is built on the top of the equipment so that the complete circuit-breaker is shipped as a single unit, except the doors and anchor bolts, with all adjustment of contacts and mechanism parts made and locked. This reduces the installation work to the connection of terminals and the placing of mounting anchors in the structure walls. A two-pole single-throw switch mounted on the operating mechanism permits the disconnecting of the control circuits when desired.



E-9 Circuit Breaker With Tank Removed.

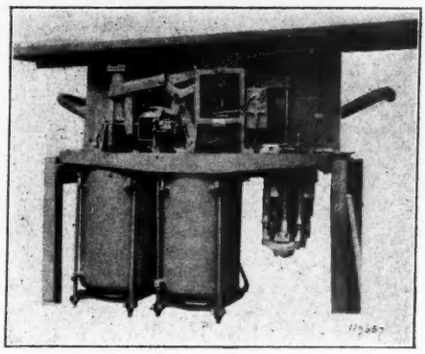
As shown, particularly in the rear view, the leads of the circuit-breakers used at Echota have been spread out in such a manner as to utilize to the best advantage the available space that was left so that either of two types of equipment could be installed. The normal design of the CO-2 circuit-breaker used at the terminal house has the leads taken directly back in such a manner that it can readily be mounted in a much narrower cell than was allotted to them in the installation. These circuit-breakers are electrically operated by the solenoid mechanism mounted on the cell top. The circuit-breaker is closed by a solenoid and is held closed by a hardened steel latch and a trigger which engage automatically. This as well as all of the other electrically operated circuit-breakers for this installation has been designed for use on a 220-volt, d-c. circuit and will operate satisfactorily over a range of from 200 to 280 volts. The CO-2 circuit-breakers, of which there are 20 of the 2000-ampere capacity and 16 or the 800-ampere capacity, have a device known as a cut-off switch supplied as an integral part of the electrical operating mechanism. It is a combined control relay, mechanical cutout and magnetic lockout. The control relay handles the closing-coil current so that a separate control relay is not required. The mechanical cutout feature opens the closing-coil circuit as soon as closing of the circuit-breaker is assured, thus saving power. The magnetic lockout prevents re-energizing the circuit-breaker closing-coil circuit until the master control switch is returned to the off position and reclosed. These circuit-breakers are therefore full automatic on overload.

Closed Compartments With Interlocked Doors Provided for Circuit-Breakers.

The circuit-breakers are designed for mounting in brick, concrete or steel structure compartments and no intermediate structure walls are required for supporting the individual poles, all of them being supported from the common steel top. The circuit-breaker is supported in the structure compartment by means of anchor plates set in and projecting from the cell wall. The steel top of the circuit-breaker rests on these anchor plates, and bolts hold it securely in place. The space within the circuit-breaker top and the floor in front of the tanks is covered with removable doors.

F-2 Circuit-Breaker With Tank Removed.

The tanks are 20 in. in diameter and are provided with two sets of removable micarta insulating linings, the inner one being short and extending somewhat above the point where the arc is interrupted. The high interrupting capacity of these circuit-breakers is due to the form of tank, the use of steel supporting flanges and steel tie rods, steel tops, the large volume and head of oil together with the high speed arcing tips and rapid acceleration of the moving contacts when opening. Operating mechanisms are mounted on the top of the steel bedplate from the under side of which the tanks are supported. The lift rods attached to the moving contacts of each pole are connected to a common operating mechanism actuated through a toggle lever by the solenoid operating mechanism. A powerful accelerating spring is provided as an integral part of the operting mechanism to assist gravity in forcing the circuit-breaker to the open position. An air-cylinder dash pot in conjunction wtih the leather bumpers on each pole brings the moving part to rest without shock. A screw needle valve regulates the size of opening through which the air escapes from the air cylinder and so governs the dash-pot adjustment. Sheet-metal partitions are inserted between the operating mechanism and

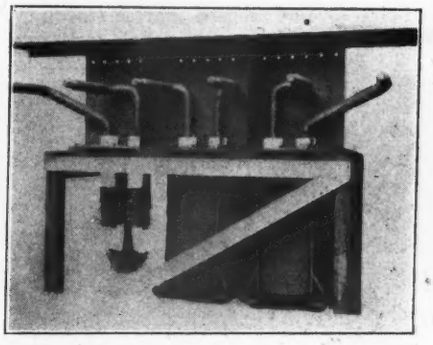


Front View of a CO-2 Circuit-Breaker.

the terminal leads and also between the leads of adjacent poles.

In these circuit-breakers the main moving contacts are of the laminated-butt brush type. The form of the laminations is such as to provide an end-on contact at maximum pressure between each lamination and the stationary contact. The brushes have a wiping or self-cleaning action during the motion of opening and closing, which action cleans both the stationary and the moving contact faces. Arcing contacts are provided consisting of a short and rugged form of spring-actuated copper horn mounted between and outside the main contacts and making contact with the head of a removable stud on the stationary contact. Each part can be easily replaced at little expense. The arcing contacts open only after the main contacts have separated a considerable distance. As they are placed outside the main contacts the magnetic-blowout effect of the current blows the arc away from them, thus fully protecting the main contacts from any possibility of arcing.

After the leads pass upward from the compartment back of the circuit-breakers in the switch house at the top of the hill they pass into choke coils. These choke coils are built similar to current-limiting reactors, while the coils at the Echota end of the line are intended for lightning protection only and are not used as current-



Rear View of a CO-2 Circuit-Breaker.

limiting reactors. They are, however, thoroughly braced to withstand any short-circuit to which they may be liable.

Main Switching of Generating Units Provided for at Echota Substation.

For the three new units, Nos. 16, 17 and 18, the main switching is provided at the Echota substation. There are five sets of feeder circuits, each normally fed from one of the 32,500-kv-a. generators or from several underground circuits from station No. 3. These groups are normally arranged for independent operation, but can be connected together through the bus tie.

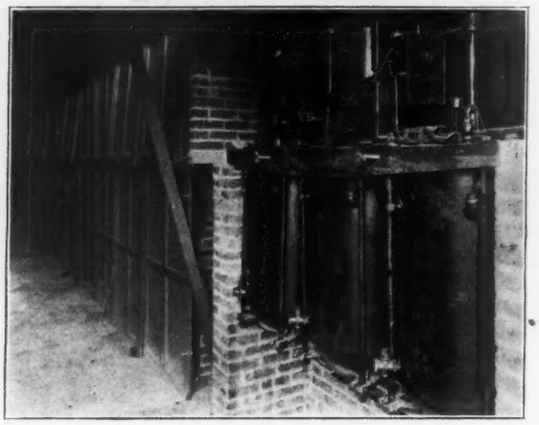
In the rear view of the Echota substation the two-story bay at the right contains the operating room, the next two bays are for the group circuits fed by cables from the old No. 3 station and the last three bays are for the group circuits fed from Units Nos. 16, 17 and 18. The front of the building connects the various bays together and contains the bus tie, incoming line connections, choke coils, etc.

Certain feeder circuit-breakers are automatic on overload, ground, reverse power, or on differential action, depending on the particular relays involved. The annunciators mentioned later in connection with the switchboard panels are provided with separate drops to indicate what particular relay has functioned to trip out a circuit-breaker, thus indicating to a station attendant whether the action was caused by overload, reversal of energy flow or other causes.

An accompanying illustration shows a view taken from the gallery connecting the ends of the various bays looking toward the oil circuit-breakers, these being of the CO-2 construction as described in connection with the apparatus at the switching station at the top of the cliff. These

Rear View of Echota Substation, Showing Five Switch Houses.

circuit-breakers at Echota have their tanks and mechanisms on an outdoor balcony with doors in front of the tank and operating mechanism, the doors being so interlocked that the circuit-breaker must be in the open position before the compartment can be opened. The disconnecting switches back of the circuit-breakers are also closed in by doors. The doors back of each particular circuit-breaker are tied together so that all three open together. These are also interlocked with the circuit-breaker so that the doors cannot be opened if the circuit-breaker is in the closed position.



Circuit-Breaker Galley, Showing Doors Removed From One Compartment.

Separate Five-Panel Board Provided for Control of Each Unit.

In the view taken in the control room from the left end next to the d-c. panels the three switchboards shown near the right-hand end of the illustration are the three 5-panel boards used in connection with units Nos. 16, 17 and 18. On these five-panel boards the left-hand panel contains the bus instruments. The second panel controls the incoming line and is provided with three 2000-ampere ammeters, one polyphase indicating wattmeter, one power-factor meter, one synchronoscope, two 18,000-volt voltmeters with a three-way voltmeter switch, synchronizing receptables and control switches with red and green indicating lamps used with the various circuit-breakers. In this installation the green lamps are utilized to show when a circuit-breaker is in the closed position, the red light shows when it is in the open position and a complete miniature bus has been placed on the board to show the main connections made by the circuit-breakers.

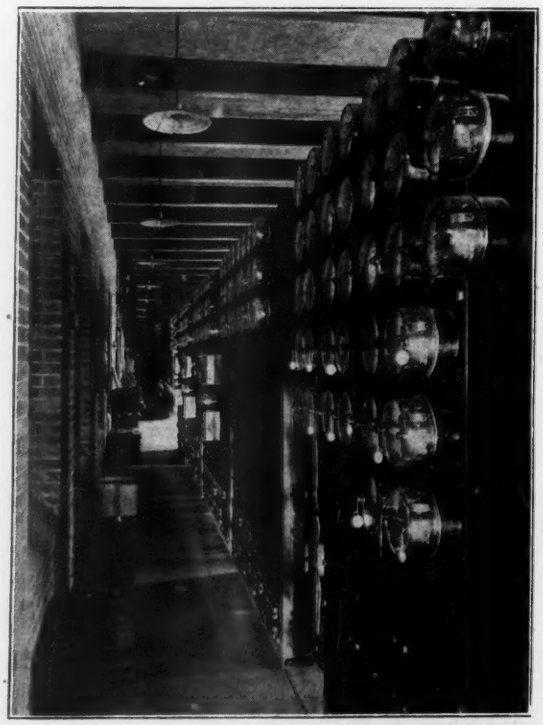
Each of the three remaining panels in each section is used for the control of two feeder circuits, each feeder being equipped with three ammeters, a polyphase indicating wattmeter, a two-drop annunciator, the control switch with red and green indicating lamps and a card holder to contain the name of the circuit. Mounted above the board is an indicating lamp that lights up the same time that an alarm is sounded in case any of the relays have caused a circuit-breaker to open automatically. The lamp will show immediately to the station attendant which one of the switchboards controls the circuit that has been opened, and the annunciator will show which particular circuit has been operated and whether it was tripped out by overload, differential protection or some other cause.

Relay Panels Mounted Back of Main Control Switchboard.

The relay panels are set back-to-back with the control switchboards, there being a five-panel relay board back of each of the five-panel control boards. The relay panel used in connection with the incoming line circuit is equipped with a total of six type GO definite-minimum inverse-time-limit overload relays and three type C differential relays. Reverse-power relays will cut out the circuit-breaker in the line circuit connecting the line to the main bus. One of the sets of three overload relays is used to automatically trip out the circuit-breaker connecting the generator to the reserve bus. As stated before, this acts practically as a feeder circuit-breaker whenever a feeder is connected through disconnects to the reserve bus. The remaining set of overload relays is used to secure automatic tripping of the circuit-breaker.

A relay panel immediately adjacent to the relay panel for the incoming line is provided with six type CO relays furnishing overload and ground protection for two feeder circuits. The two remaining panels are provided with six overload relays and six differential relays to provide overload and ground protection and split-conductor protection for two circuits per panel. The two remaining a-c. switchboards control incoming line circuits from the old generating station No. 3 and a number of outgoing feeder circuits.

The board at the left in the control room is the house-service switchboard. The two panels near the left-hand end are provided with knife switches and fuses used in the control circuit for the various groups of lines and feeders. Space has been left on these two panels, as well as on the

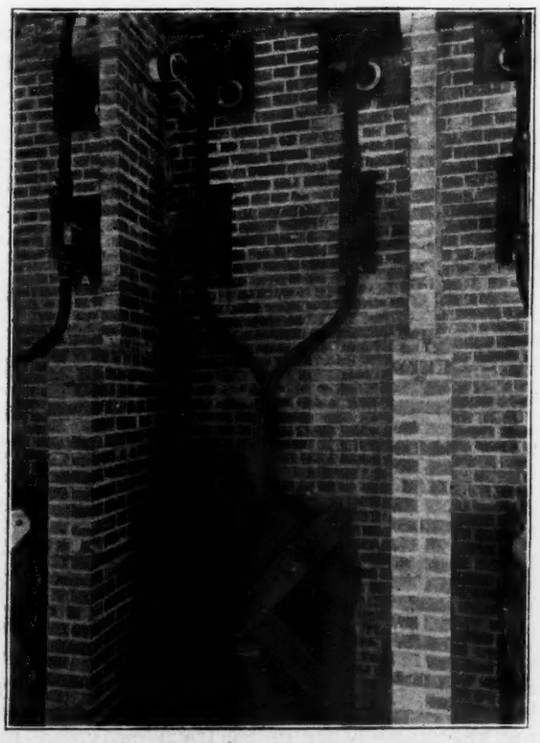


Relay Panels at Echota Substation Mounted Back of Switchboard.

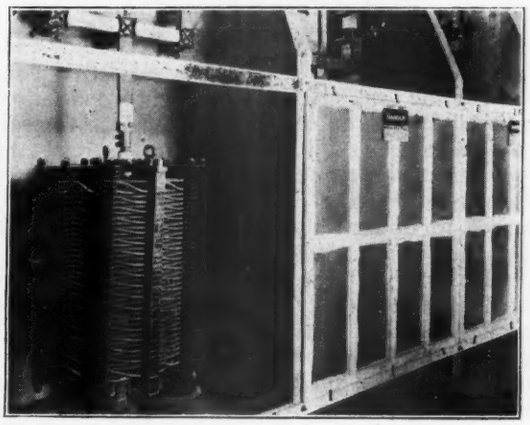
third panel, for future switches and fuses to take care of additional control circuits at a later date. The next panel is used for the control of a storage battery similar to that located at the generating station, and provision is made for an automatic throw-over switch to transfer circuits from the generator bus to the storage battery. The next two panels are each used for the control of a motor-generator set for battery-charging purposes. The three remaining panels control a main incoming circuit from the station-service transformers and a number of 220-volt, three-phase distributing feeders.

In the general arrangement of this plant and, in particular, the switching equipment there are a number of interesting and unique features developed by the Niagara Falls Power Co. The method of excitation used, omitting a generator-field rheostat and utilizing a separate motor-driven exciter for each unit, follows a scheme originated by the Ontario Power Co. This scheme saves the cost and space occupied by generator-field rheostats and eliminates the losses in them. To guard against the possible failure of a motor-driven exciter, causing the shut down of a large generator, special provision has been made for a series rheostat that can be cut into the field circuit of any unit when it is desirable to excite such a unit from the 220-volt, d-c. bus.

Advantage has been taken of the various schemes of differential protection secured by bringing out all of the leads from the generator winding, and by securing split-conductor protection by the use of two leads in parallel each equipped with current transformers. The location of the main paralleling buses and distributing switching equipment at Echota, instead of at the power plant 3 mi. away, has been very thoroughly worked out and has proven to be entirely satisfactory. Use of annunciators with special drops to show the cause of the tripping out of any particular breaker and the idea of combining the signals between the generator platform and the switchboard room are among the other novelties produced in this plant. The location of circuit-breakers of high rupturing capacity and moderate voltages with their tanks and operating mechanisms outdoors, but their connections indoors, was worked out for the first time for this installation.



Choke Coil Installed in Generating Plant at Niagara Falls.



Choke Coil Installed in Substation at Echota.

SPECIFICATIONS APPROVED FOR TRANSFORMER OIL.

Specifications recently adopted by the Union des Syndicats d' Electricite requires that only absolutely pure mineral oils obtained from the fractional distillation of petroleum be used for the insulation and cooling of transformers. Two qualities of oil are defined by the specification. The first quality must fulfill the following requirements:

There must be no deposit after heating for 5 hrs. at a temperature of 150 deg. C.; after 50 hrs. the weight of deposited sludge soluble in carbon tetrachloride must not exceed 0.06%, or after 100 hrs. 0.3%. The flash point must not be below 180 deg. C. Viscosity must not be above 8 (Engler) for a temperature of 20 deg. C., and 2.5 for 50 deg. C. Loss of weight by evaporation shall not exceed 0.2 deg. after treatment for 5 hrs. at 100 deg. C. Density must be between 0.85 and 0.92 at 15 deg. C. The thawing point must not be above —1 deg. C., and the oil must not contain more than 0.2% acid (H_2SO_4) and no alkali or sulphur. It must be practically free from water. The insulating power must be such that no sparking will occur between spheres of 0.49 in. diameter set 0.195 in. apart at 40,000 volts alternating current.

The second-quality oil is only to be used for transformers which are little subject to heating, such as instrument transformers, etc. The permissible limits for sludging are 0.09% for 50 hrs. and 0.45% for 135 hrs. The viscosity at 20 and 50 deg. C. must not exceed 9 and 3 respectively.

Organization and co-operation make men out of nonentities.

More fires are prevented than caused by electricity.

VITAL NECESSITY FOR ELECTRICAL INDUSTRY'S EXPANSION.

Future Construction Dependent on Proper Support of Public Utilities, Says M. H. Aylesworth to Chicago Electric Power Club.

In an address before the Electric Club of Chicago, Feb. 1, M. H. Aylesworth, executive manager of the National Electric Light Association, touched on the problems confronting the central-station companies in their efforts to raise the money necessary to provide the electrical capacity needed to take care of the power load required for industrial developments and domestic consumers. Mr. Aylesworth said in part:

"The first problem which must be solved by all branches of the electrical industry is, 'Are we big enough—have we the vision, the intelligence and the enthusiasm to provide the capital necessary to develop the United States electrically, and can we pull together in harmony so that this can all be accomplished in the shortest period of time?

"It has been my pleasure to visit every state in the United States during the past year, and I make the prophecy that the electrical industry can and will carry this stupendous load without faltering and without hesitation. The first and, no doubt, the main link in the chain of electrical development is the electric light and power company, for, unless it can obtain capital to produce the electrical energy with which to provide the vast power load which is necessary for industrial development, and unless the money is forthcoming to provide electrical capacity for at least 6,000,000 of the 8,000,000 unwired homes of the country and for the 1,250,000 homes which must be built to relieve the housing shortage, our mission will have failed. The electric light and power branch of the industry has applied for 10,000,000 hp. in licenses before the Federal Water Power Commission and it may be conservatively stated that this branch of the industry must raise from $3,000,000,000 to $4,000,000,000 in the next 6 years to provide the capacity which the country demands. This must all be accomplished so that the people in industry or in the home can have those modern electrical conveniences that the country requires at once. Speaking conservatively, this means that the other branches of the electrical industry—the manufacturer, contractor-dealer and the jobber—will sell to the customers on the lines of the lighting power companies $8,000,000,000 of equipment for use in the home, in industries and office buildings.

"Speaking selfishly, it is to our interest—the interest of the entire industry—to see that this program is carried out in the shortest possible time, and without complete harmony and a steady pull it is impossible. While it is true that 1,500,000 customers of the electric light and power companies are holders of securities of those companies, it is impossible by legislation or force to compel these people to retain their ownership in these utilities, and it is impossible to force these same people to buy more securities or to compel the millions of people who have not invested to place their resources in electric light and power development; and all of this money must be forthcoming voluntarily, and this can be brought about only through square treatment to the electric light and power owners. Sufficient rates must be permitted to give confidence to the man or woman with money to invest, otherwise these extensions of plant and lines cannot be met, and if they are not met the manufacturer, the contractor-dealer and the jobber will suffer even more than the electric light and power company. Let us get acquainted with each other by becoming familiar with the problems of each branch of the industry and then boost together. If we do this and do it at once we will profit financially and render a service which the public will appreciate and be willing to pay for."

Mr. Aylesworth defended state regulation, showing that the electric service was no longer local, but was of state and nation-wide importance. He brought out the fact that banks are really public utilities and no one would contend that they should not earn a fair rate of return, nor would it be contended that local politicians should act as bank examiners or bank regulators.

Hearing on Proposed Abolition of Arkansas Corporation Commission.

Mr. Aylesworth spoke in defense of the Arkansas Corporation Commission at Little Rock, Jan. 27, before the senate Committee on Public Service Corporations, Senator R. C. Stewart, a member of the committee, having invited Mr. Aylesworth to appear before such committee and state his views of the matter. The occasion was the second hearing of the committee, of which Senator George Hartje, Conway, is chairman, on the question of the proposed abolition bill fathered by Senator Houston Emory, creator of the Corporation Commission in 1919, and Senator Charles Walls, Lonoke.

In his remarks before the committee Mr. Aylesworth traced the history of corporation control from its beginning in America, and told of the various advantages of state-wide regulation of utilities. Among them, he said, are uniform service and rates to the consumer, cheaper money and a more permanent policy for the corporations. He showed how private investors were not favorably disposed towards utilities subject to the necessity of constant litigation with the public, and declared that absence of state control made it harder for the utilities to attract working capital. Increased cost of money to the corporation must always result in increased cost of service to the public. Banks, he said, are public utilities, and yet no one nowadays would argue that they ought to be made political footballs as a result of local regulation and control of city or town councils.

TO CONDUCT COURSE FOR ELECTRIC METER MEN.

The University of Wisconsin has announced a short intensive course for electric meter men, which will be conducted in co-operation with the Railroad Commission of Wisconsin and the Wisconsin Electrical Association at the engineering college laboratory, Madison, from Jan. 31 to Feb. 4. The purpose of the course is to assist the electric utilities of Wisconsin in the training of men in the theory of operation, testing and maintenance of electrical measuring instruments.

Electrical Distribution System for Modern Concrete Factory

Details of Power and Lighting Installation Involved in Construction of Industrial Plant at Barton, Wis.—Rigid Conduit Laid in Concrete During Process of Construction of Building

By C. P. TRUEAX*

Within the past few years rapid strides have been made in the standardization of design of equipment for generating and utilizing electrical energy. The manufacturers of turbo-alternators, motors, lighting fixtures, lamps and accessories have more and more approached a standard design of their products. Along with this same general trend of the electrical industry, engineers, industrial plant managers and those responsible for the selection of equipment have specified it with a view toward standardization and interchangeability of their plant layout.

Unfortunately, however, the design of the electric wiring distribution system has not received the corresponding amount of attention or kept pace with the progress of standardization. It is true that the distribution system, from its very nature, is not capable of being standardized in design to such an extent as the equipment which generates or consumes the electrical energy transmitted by it, due primarily to the fact that each industrial wiring layout is more or less a made-to-order proposition and must be studied and so designed to meet individual requirements.

The importance of the part the wiring distribution system—the wires, conduits, junction boxes and switching equipment—plays in the shop or factory cannot be overestimated. Its relation to the layout as a whole may be likened to that of the blood circulation system of the human body to the proper functioning of same. It is the connecting link between the source and utilization of electrical energy.

Consideration of Elements in Wiring Industrial Plants.

The four fundamental requirements of an efficient electric wiring distribution system are Safety, Reliability, Economical Distribution and Flexibility. Safety, the first requirement, applies to safety of life and property. The system must be so designed and installed as to reduce to a minimum the liability to accidental contact with current carrying parts and to lessen the fire hazard. The first, primarily humanitarian, also resolves itself into a financial question when workmen's compensation laws are taken into account.

Reliability is of vital importance in the wiring system; to be reliable it must insure continuity of service by guarding against shutdown from any possible contingency.

Economical distribution is largely a matter of first cost about which much has been written in the technical press. The economical selection of conductor sizes takes into consideration the resistance or I^2R loss charges and the investment charges. In an industrial wiring system it is the question of getting the right amount of copper in the right place.

In the average plant, manufacturing processes are constantly changing, necessitating both the shifting of present machines and installing of additional ones. Future extensions and additions to existing buildings are frequently contemplated to provide for expansion. The wiring distribution system, to meet both the present and future needs of any plant, is required to possess flexibility. By any change in the location of load centers or additional load requirements the wiring system, to be flexible, should be able to meet these conditions without having any undue amount of capital tied up in idle equipment or causing undue expense or shutdowns for making changes or additions to the system.

Requirements Governing Electrical Installation for Modern Machine Shop.

The foregoing requirements governed the design of the electric wiring for light and power for The Woodford Engineering Co.'s new machine shop at Barton, Wis., a medium sized shop of modern reinforced concrete construction. The main features of this layout are briefly described in the following:

The shop in question is a two-story reinforced concrete structure, the floors being of reinforced girderless floor construction with concrete columns, brick spandrel walls and brick and tile partitions. The main portion of building is 45 ft. wide by 120 long, with an adjoining boiler room one story high, 22 by 34 ft., making a total floor area of approximately 11,550 sq. ft. There is only one row of interior columns down the center of building spaced 20 ft. apart.

It is planned to extend the length of building two bays to the south and add another story at some future date. Provision in the wiring layout had to be made for these future extensions.

The building is to be used for light manufacturing and assembling of automatic quarry haulage machinery with machines arranged for individual motor drive. Neither the immediate connected power load nor the exact location of machines was definitely fixed at the time the wiring layout was designed. This much information, however, was available—the motors would be small, averaging between 1½ and 3 hp., with 5 hp. as the maximum, and the motor-driven machines would be located along one side of the shop, with a spacing of approximately 7 ft. It

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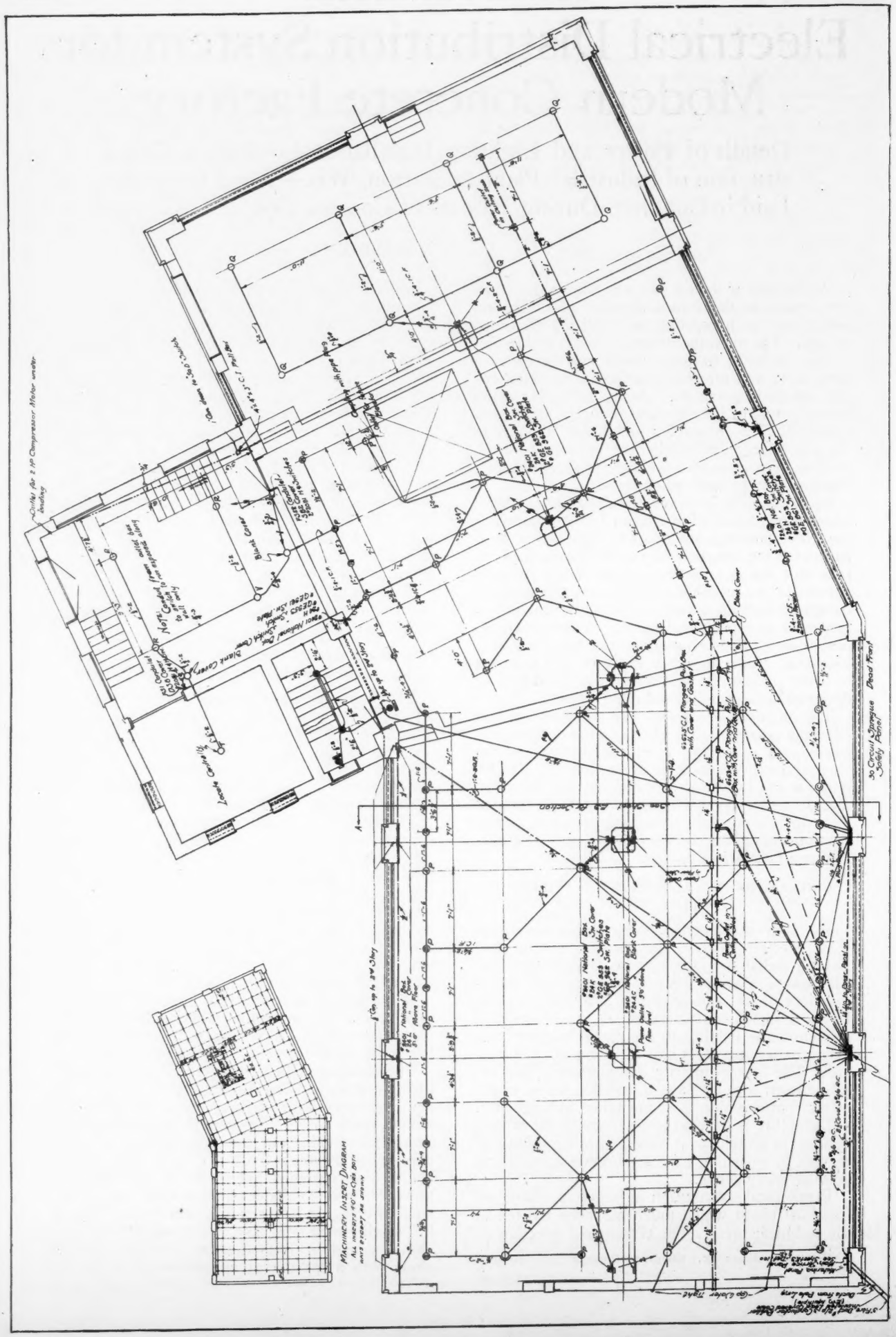


Fig. 1.—Plan of Electric Wiring for First Story, Woodford Engineering Co.'s Machine Shop, Barton, Wis.

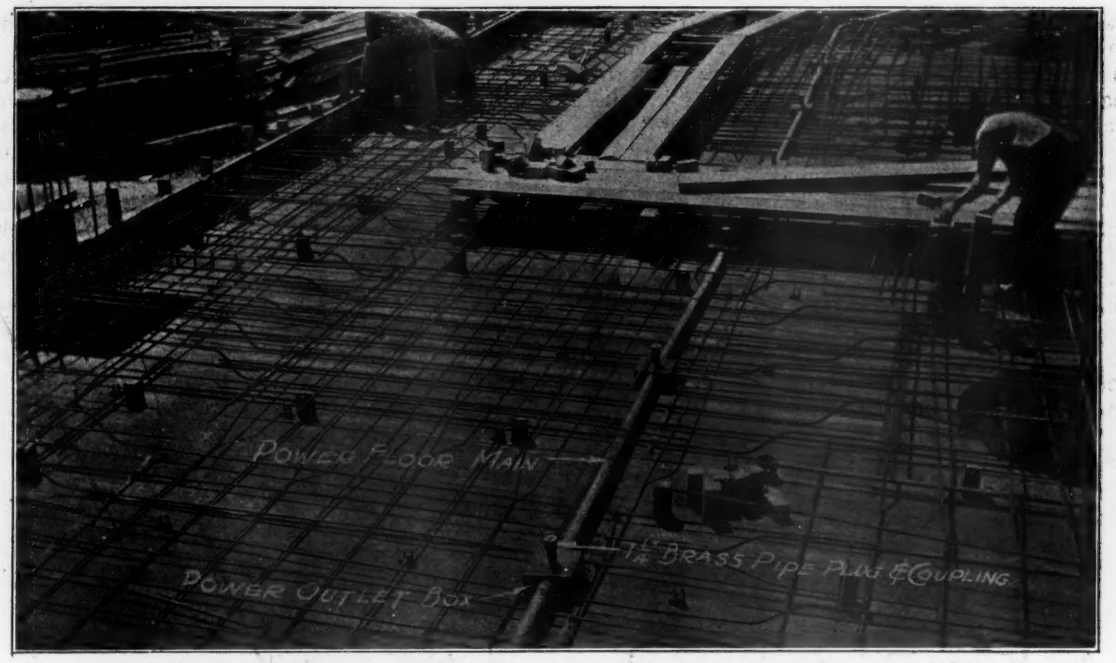


Fig. 2.—Construction Progress Photograph Showing Power Floor Mains and Outlets.

was further decided that benches would be located along the outside walls for bench work and fine machine work.

With the above data at hand the wiring distribution system was designed, using concealed rigid conduit throughout.

The service enters the building underground in Orangeburg fiber conduit from transformers on a nearby pole. From the service switches located on first floor, where metering facilities are provided, main feeders are run in first floor slab to centrally located pilasters upon which are mounted panel boxes for light and power. The location of these panel boxes are shown in Fig. 1 which shows the wiring plan for first story of building. The conduit for lighting is oversize in several in-

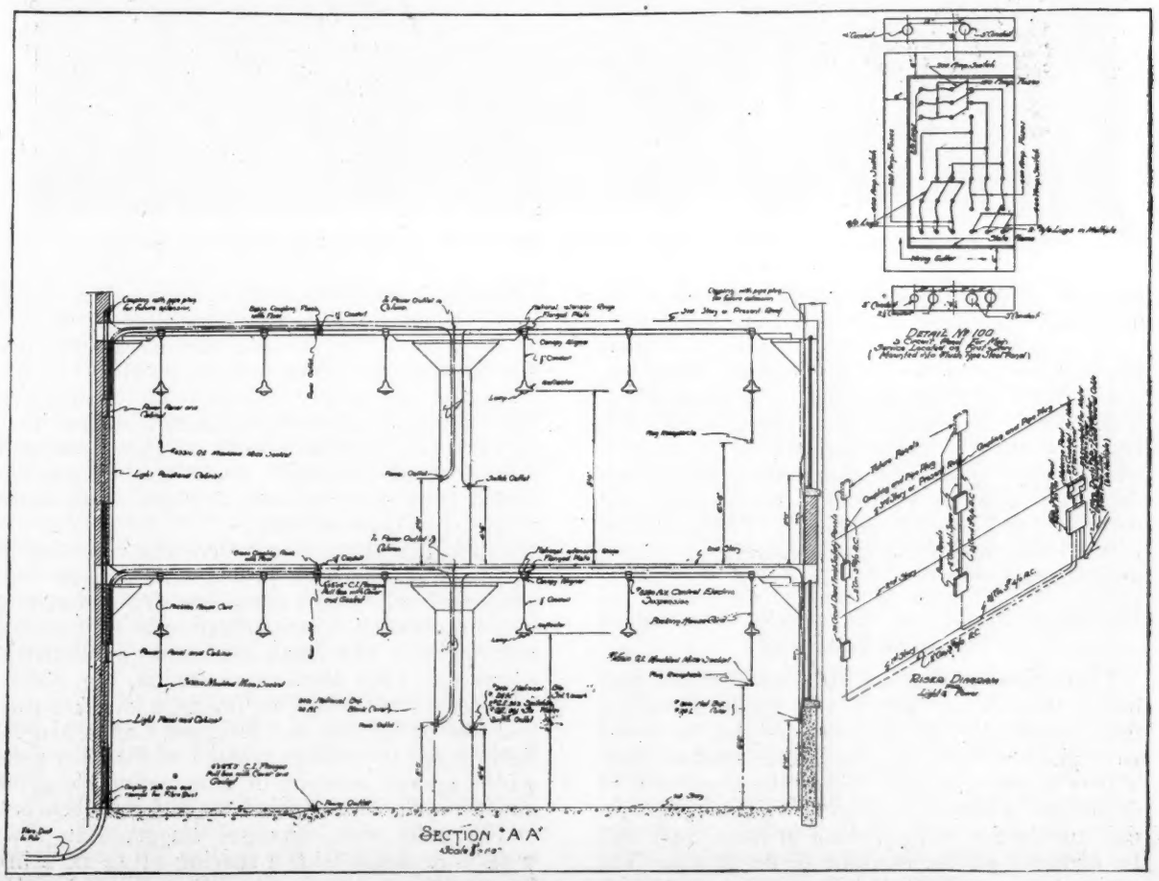


Fig. 3.—Detail Cross-section.

stances to provide for alternate switch control and future rearrangement if desired at an almost inappreciable increase in cost. Owing to the market conditions at the time this work was installed 1-in. conduit was not obtainable, making it necessary to substitute 1¼-in. conduit instead.

Feed for panel boxes is supplied by risers running from floor to floor, consisting of cables of sufficient capacity installed in conduit to take care of the estimated connected load, the demand factor being taken into consideration. By this method changes of load between floors will not affect the main feeders. Conduit only was installed from the second floor panel boxes to a point above the roof line and capped watertight to be extended to the future third floor when it is added.

The problem of providing a flexible wiring system for power, outlets of which would be within reach of all possible locations of machines to be installed, was solved in the following manner:

Floor mains were installed in each floor slab running the entire length of building down one side about 8 ft. from the central row of columns, with floor outlets spaced 7 ft. apart. From the last floor outlets nearest the end of building to which future extensions were contemplated, conduit was installed, projecting just through the outer wall and capped watertight. This was done with all floor mains to provide current for future requirements.

Provision Made for Extending Service as Plant Is Enlarged.

These floor outlets consisted of cast-iron pull boxes with brass covers and gaskets, making them watertight. In the first floor slab the boxes were placed with covers flush with finished floor. Where a motor feed is desired the cover will be drilled and a short length of flexible metallic conduit run to the motor, which in most cases will be mounted on the machine to be driven. The outlet boxes not used will not interfere with trucking, and are always ready when necessity demands their utilization.

In the second floor slab and roof slab, which will be the future third floor slab, the boxes were installed with cover flush with underside of slab and the back or top of the box was drilled for 1¼-in. conduit; the thickness of slab permitted the use of a short nipple with 1¼-in. brass coupling flush with floor. As in the case of the first floor, outlets where power is required will be fitted with flexible metallic conduit from the brass coupling to motor. Where the outlets are not used countersunk brass-pipe plugs will be inserted so as to be flush with finished floor and not interfere in any way with trucking over same or the placement of machines. The power floor mains and outlets are very clearly shown in the construction progress photograph, Fig. 2.

Fig. 4.—Construction Progress Photograph Showing Light Outlets Along Outside Wall Over Benches.

Should it be desired to install a ceiling hung motor, connection can be made to the outlet box through the cover in same manner as that described for those in the first floor slab.

Conduit runs were provided from the distribution panels to floor mains in such a manner that an extremely flexible system of connection and control could be made. Spare conduit was installed from panel to panel at risers to take care of transfers between floors.

In addition to the power floor mains a number of power outlets were provided on interior columns and on pilasters along one side of building over benches for electric soldering irons, portable electric drills and small miscellaneous electrical equipment. (See detail cross section, Fig. 3.

In regard to the lighting layout, a localized general type of lighting was designed, that is, general lighting for the greater portion of the shop area, with a greater intensity of illumination along the outside walls next to windows and over benches.

The units were arranged staggered in rows 7 ft. 1 in. apart with a spacing of 14 ft. 2 ins. between units in each row. (See Fig. 1.) This

gave a uniform spacing of units of approximately 10 ft. Along the outside walls over benches where more illumination was required on the working plane the units were spaced 7 ft. 1 in. apart on a single line. Outlets for these units are shown in construction progress, Fig. 4.

Details of Illumination and Control of Lighting Units.

In one portion of the building which is to be used exclusively for storage purposes the spacing was somewhat greater with only four outlets per bay arranged in the usual manner.

Construction progress, Fig. 5, gives a general view of the conduit work for second floor slab before pouring of concrete and is typical for second floor and roof slab. Outlet boxes are shown next to outer wall for light outlets over benches; power floor main is shown with a line running from pull boxes of same over to pilaster on which panel boxes are mounted. Some of the light outlet boxes in main portion of building are also shown.

Fig. 5.—Construction Progress Photograph Showing General View of Conduit Work for Second Floor Slab.

For the lighting outlets deep type extension rings with separate flanged plates were used, permitting the conduit to enter the ring above the reinforcing bars without bending, and also facilitating the installing of same without the necessity of turning the box upside down to screw on locknuts and bushings. In place of outlet box covers canopy aligners were used, thereby permitting the fixture to always hang in a vertical position and absorb the shock should fixtures be struck by any object.

R. L. M. Standard dome porcelain enameled steel reflectors, mounted 9 ft. above the floor with 150-watt Mazda C bowl enameled lamps, were used.

With the above spacing and mounting height of units, type of reflectors and size and type of lamps used, the system was designed to give an average resultant intensity of illumination on the working plane of about 9-ft. candles, assuming a utilization factor of 50%. The intensity is somewhat higher along the outside walls next to windows where bench work and fine machine work will be done.

The control of lighting units was arranged by grouping the outer rows in circuits parallel to windows, with the units in the interior portion of shop grouped with relation to bays. All lighting circuits were provided with individual switch control, using tumbler type flush switches located conveniently on the building columns. The outer rows of units were switched in such a manner that alternate outlets could be separately controlled, depending upon the amount of illumination required with varying daylight conditions.

To provide for lighting in the future extension to building conduits were run from each lighting panel box to the end of building and extended through the wall with ends capped securely against water.

The design of the entire building was made by Condron Co., engineers, engaged in the design of industrial buildings and plants, with offices in Chicago and Akron, O., under the direction of A. M. Wolf, secretary and engineer. The electrical distribution system was designed under the writer's supervision and the actual installation of the system was supervised by S. J. Chakow, assistant electrical engineer. L. M. Harper acted as supervising engineer in charge of the entire project.

A German committee has issued a set of revised regulations for the standardization of porcelain insulators for high-tension transmission lines, supporting pins for insulators, low-tension insulators for use in inclosed rooms, and gives particulars of tests to be made on insulators designed for voltages from 500 to 35,000 volts. These include electric and heat tests, and tests for mechanical strength and porosity.

Future of Electrical Construction Aided by Utility Laws

Illinois Utilities Commission Upholds State Laws in Granting Increased Rates—Previous Contracts with Municipalities Nullified by Utility Law—Courts Sustain Necessary Rate Increases

By JAMES H. WILKERSON
Former Chairman, Illinois Utilities Commission.

The Public Utilities Commission of Illinois has had to do with the Chicago traction situation only as the agency of the state government through which the general regulatory law applicable to all public utilities within the state has been applied to these particular companies. The commission does not possess arbitrary power. It may not act from whim or caprice. It must not consider political expediency. Its orders should not be issued for campaign purposes. Its decisions are not to be framed to conform to what it may imagine is a popular verdict at the polls.

The commission is subject to constitutional limitations and to the rules laid down in the statute which created it. Whatever the opinions of its individual members may be, the commission has no concern as an administrative body with the wisdom of the law under which it operates. Its duty is to enforce the law as it finds it, and for the result it is answerable to the courts only.

Thus far, the commission has been true to this fundamental conception of the rule by which its acts should be guided. So far as the Chicago traction question is concerned, the rulings of the commission have been upheld in every case in which they have been questioned in either the supreme court of Illinois or the supreme court of the United States.

We are living in strange times. Doctrines are being pressed in the name of the people, which are utterly destructive of representative government. Constitutions are nothing; statutes are nothing; decisions of the courts are nothing. Public officials are to be condemned and discredited, not because they have destroyed the law, but because they have dared to respect and to follow it. It is high time for Illinois to return to first principles if it is not to be shamed and discredited in the eyes of the entire nation.

Utility Law Seeks to Eliminate Politics and Protect Property Rights.

The public utilities law of Illinois, effective Jan. 1, 1914, took away the rate-regulating authority from the municipalities and transferred it to the utility commission as the agency of the state. The law laid down one uniform, invariable rule applicable to all rates in Illinois. It leveled all inequalities resulting from attempts to bargain away the state's authority to require and to grant just and reasonable rates. It struck down all discrimination. It placed the service of all public utilities in the state under one supervision.

This law was the application to Illinois utilities of the same methods of regulation which the government had worked out after an experience of a quarter of a century in dealing with the railroads. It was based upon the experience of many other states. Its purpose was to take street cars, gas, and electric light out of every local municipal campaign and prescribe a fixed rule by which values and returns could be determined, subject to final review by the courts. It aimed to restore credit and to stabilize investments.

The financial standing of the state for a generation to come may be determined by the action which is taken this year on the proposal to throw great investments into the field of continuous political controversy because of a popular clamor, brought about by a false appeal under disturbed conditions following the war, and to repudiate the methods of regulation which not only the United States but practically every state has found to be wise and beneficial.

For a few years after the utilities law became effective, the activity of the commission, so far as rates were concerned, was largely in the direction of reducing them. Until 1918, there was no complaint by the public, the city, or anyone else as to fares of the local transportation companies. Their schedules containing the ordinance rates had been duly filed and had become effective under the public utilities law. Then came the war, with wage advances, increased cost of materials, and increased cost of operation generally. Under these conditions, there could be but one result as to the rates of utilities.

The situation is no different in Illinois from what it was all over the country. The application of the transportation companies of Chicago for relief was similar to those made by almost every utility in the state and in the United States. The same questions as to the effect of the so-called contractual provisions in the ordinances were raised in scores, indeed in hundreds, of other cases.

Factors Considered in Determination of Rate Increases.

Orders granting advances, which were made before the conclusion of the valuation proceedings, were temporary in their character. In fixing the rates, the commission followed the rule that it would allow to the companies only enough to pay operating expenses, taxes, make a fair allowance for depreciation, and in addition thereto, give a fair return upon the lowest value which, in the contemplation of reasonable men, it was

possible to assign to the property of the applicants for rate-making purposes.

In each of these cases, the temporary orders required the companies to supplement the preliminary showing by a presentation of complete evidence as to the values of the properties for rate-fixing purposes. In making these valuations, the action of the commission was controlled by definite rules which had been prescribed by the supreme court. The commission was required to give substantial consideration to the elements of original cost, cost to reproduce the property new, less depreciation, and going value as an industry.

Law and Courts Protect Utilities in Right to Fair Rates.

The law entitles utilities to just and reasonable rates, that is, to rates which will give a fair return upon the fair value of the property employed in the public service. To require utilities to adhere to confiscatory schedules and to deny to them the rights to which they are entitled under the law is to deprive them of their property without due process of law.

Passing the right of appeal to the state courts, there can be no doubt that in case the utility commission attempts to compel adherence to a confiscatory rate, the utility has the right to resort directly to the federal courts for protection, and that, without exhausting the remedy of appeal to the state courts. If the commission, therefore, had denied to these utilities the rights given to them by the state law, the only effect would have been an abdication by the state authorities of their regulatory power, and to transfer control over the rates of these utilities to the federal courts.

This right to resort to the federal courts under such circumstances has been made so clear by federal decisions that it cannot be seriously questioned.

It has been asserted that such arbitrary action on the part of the commission does not entitle the utilities to relief, because the so-called rate contracts are something which it is asserted the commission may respect or reject according to its own views of what the public welfare requires. The contention appears to be that if the commission decides that the public welfare requires observance of the rates specified in the new ordinance, that decision of the commission is not subject to court review on the ground that its effect is to deprive the utilities of the fair return on their properties to which they are entitled under the law.

This view, it appears, proceeds upon the erroneous assumption that it is within the power of the legislature to delegate to an administrative board arbitrary authority of this kind. The legislature must lay down the rule by which the commission is to act, and that rule must be uniform in its application. The legislature has laid down the rule, and that rule is that all rates shall be just and reasonable, and the act gives to the public and to the utilities subject to it the right to have the rule applied.

The commission may not approve or reject these franchise provisions at its will. The law itself wiped out all those attempts to make contracts about rates, and requires adherence to the uniform rule which has been prescribed. It is the duty of the commission to act as if these attempts to contract away the rate-fixing authority of the state had never been made, and the arbitrary action of the commission in failing to perform this duty gives the right to resort to the guarantees of the federal constitution and to the federal court.

What will be the situation, it may be asked, if the utilities law is repealed? In that case, the power of regulation goes back to where it was before the enactment of the law. Of course those portions of ordinances fixing rates which were passed before the utilities law went into effect were abrogated by the law. When the utilities law became effective the rates of utilities were dependent for their validity upon compliance with the provisions of that law. The repeal of the law cannot revive those ordinances passed before the utilities law became effective. New ordinances, subject to the constitutional prohibitions against taking property without due process of law, must be passed, and those ordinances, if arbitrary or confiscatory, are subject to the same kind of attack in the courts as may be made upon the arbitrary and confiscatory acts of the commission.

The truth about this situation is this: Under the law as it now exists, or any law which it is within the power of the legislature of Illinois to enact, rates will be required by the courts which stand the test of the guarantees against confiscation of property.

Against every attempt to take private property for public use without compensation stands the constitution of the United States, and back of the right guaranteed by the constitution is the force of the entire nation.

Those who have considered the facts know that at this late day the Illinois law cannot be repealed entirely without substituting some agency through which the state may exercise its general regulatory power. The thing of immediate concern is, that so long as these utilities are operated by public service corporations under state regulation, the agency of the state, whatever it may be, which is clothed with the regulatory power shall adopt no other standard of action than adherence to the rules of law and the requirements of the constitution.

Let it never be said that in the state of Illinois there was an administrative board which, in defiance of both statute and constitution, merely rendered decisions which were made in advance for purposes of a political campaign. Let it never be said that because of a false agitation, the state of Illinois has abdicated the functions of government and has surrendered to the federal courts the duty which it should perform itself, of protecting property and property rights.

Let us make no mistake. It is not the public utilities law which is on trial in this state. It is the state itself—its credit, its financial standing, its reputation for protecting property—which is on trial. And the time has come when there must be a union of all the forces which believe in constitutional government to preserve unimpaired the credit, the integrity, and the name of the state.

SEES GREATEST CONSTRUCTION ERA IN UTILITIES' HISTORY.

Customer-Ownership Movement and Other Phases of Public Utility Situation Discussed by Official of Byllesby Organization.

In commenting on the investment outlook for public utilities stock, W. H. Hodge, H. M. Byllesby & Co., Chicago, recently stated: "The solid, substantial qualities of investments in well-managed utilities are growing clearer to investors during the present winter and their merits stand forth in bold relief as commodity prices drop and merchandise inventories shrink in value. The utilities have no high-priced goods on hand to liquidate and are able to take advantage of every drop in the prices of materials, supplies and labor. Their business for the most part continues in dull times as well as active periods and for a long interval they have been confronted—as they are at present—with a far greater demand for their product than they can under the circumstances supply. This situation will probably prevail for some time to come.

"During and since the war the larger and better-handled utilities have given a wonderful demonstration of their intrinsic soundness and their ability to survive the shocks of the most adverse conditions that can be imagined. The public attitude toward them is very different from that of 1914. The public has come to realize the inseparable importance to the individual and communal welfare of electric light and power and electric railway transportation. Moderate increases in service rates have been contrasted with doubled and tripled prices for other necessities. Disappointing results from government railroad operation have been compared with continued efficiency by the privately-owned utilities. The result has been a much fairer public sentiment and a strengthening of the hands of state and municipal bodies in granting equitable rates to the companies.

"The majority of the utilities of the United States are working nearly to the capacity of their present equipment in order to supply the demands of the present winter. Practically all are confronted with demands necessitating additional capacity and the extension of lines, mains and track. Construction of all kinds is being held to the minimum because of the high cost of materials and labor and of money. Both of these difficulties are being lessened and it would not be surprising if next spring witnessed the beginning of the greatest construction era known in the history of utilities, particularly with reference to hydroelectric development now made possible by new national legislation.

"A striking phase of public utility development of the last few years lies in bringing the public and the utilities closer together through what is known as the customer-ownership movement. A large number of progressive companies have invited their customers to become profit-sharing partners in the business, offering as a rule their preferred stocks for cash investment or on a partial-payment basis. The response of the public has been surprising. Customer-ownership is proving to be of the greatest value in improving the public relations status of the service organizations. It means popular ownership with retention of the virtues of private operation and responsibility. No more satisfactory result than this can obtain under any other condition that would give proper service."

HOW PUBLIC UTILITES CAN HELP HOUSING SITUATION.

Necessity for Utilities Raising Funds to Make Extensions, Pointed Out by American Electric Railway Association Executive.

Public utility companies of the United States will require $852,500,000 to properly equip the 1,250,000 houses and apartments which this country now needs, Philip H. Gadsden, president of the American Electric Railway Association, and a vice-president of the United Gas Improvement Co., Philadelphia, declared in a statement at a recent conference called at Washington by the Chamber of Commerce of the United States to consider the national housing situation. Only by inducing a new flow of capital into public utility securities can this vast sum of almost a billion dollars be raised when it is needed, Mr. Gadsden said. He added that this new money could be obtained if public regulatory bodies would grant utilities rates which would provide an attractive return to the investor.

"One of the most serious problems in connection with the housing situation in the United States today is the great need for money among public utilities with which to make extensions," Mr. Gadsden continued. "In order to properly equip the improperly-housed residents of the United States with heat, light, transportation and telephone facilities, the public utilities today would have to raise a total of $852,500,000. This total is reached by combining the estimates of the most reliable authorities in the public utility field. This is a most astounding total to contemplate, even in a field of industry which has good credit. Unfortunately, the public utilities field is not blessed today with good credit, hence this problem becomes doubly difficult for the operators who must furnish public service to the people when these houses finally are built.

"There is no hope of ever getting these needed extensions if the credit of public utilities is not restored. The shortest step toward restoration of credit is for regulatory bodies to permit public utilities to earn such a return on their investments as will attract new capital into the public utility securities field. Regulatory bodies must recognize the fact that many public utilities were carried to the brink of disaster by enormous costs during the war and that investment in their securities practically closed because of uncertainty of returns. If these facts are not recognized and rates regulated accordingly, needed extensions cannot be made. I am not pessimistic, however, regarding the attitude of regulatory bodies. Throughout the country they are displaying a highly intelligent grasp of the situation and are evincing a desire to play fair with the public utilities. With the co-operation of regulatory bodies, public confidence in public utility securities can be restored, and with that confidence will come a flow of money into the public service field that will make extensions possible."

Bushings for Insulation of High-Voltage Lines

Twelfth of a Series* of Articles Giving a Concise Review of the Electric Power Situation—Conductor Size Influences Stresses in Dielectric—Oil-Filled Bushing—Size of Wall-Entrance Openings

By ALFRED STILL

While no attempt is made in this series of articles to enter deeply into questions of theory and design, the principles underlying the breakdown of insulators through concentration of flux density may be brought out clearly by considering the simple case of a cylindrical insulating bushing surrounding a high-tension conductor. A high-tension bushing may break down by spark-over from the high-tension conductor to the structure (usually grounded) which supports the bushing, or by puncture of the insulating material. The breakdown voltage has usually to be determined

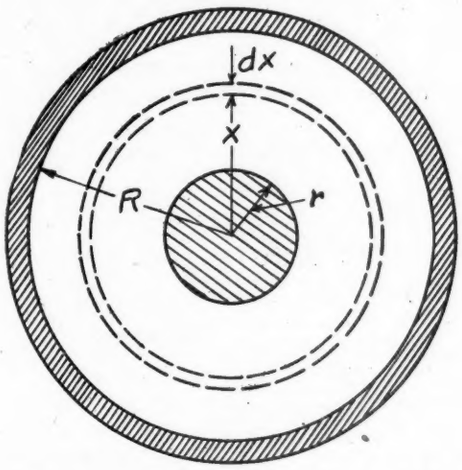


Diagram of Cross-Section Through a High-Tension Bushing.

by test, because the proportions and design of the metal fittings are rarely such that the maximum density of the electrostatic flux can be accurately predetermined. It is, however, possible to make certain assumption which greatly simplify the problem and permit of calculations being made giving results of practical value. By assuming the bushing to be of considerable length, and neglecting the effects of the ends of the inclosing metal sleeve, the formulas used in calculations on insulated underground cables may be applied.

An accompanying diagram is supposed to be a cross-section through a high-tension bushing in which the conductor has a radius r, and the thickness of the porcelain or other insulating material is R-r. Let k stand for the specific inductive capacity, or dielectric constant, of this material.

*The first article of this series was published in the July 17, 1920, issue of Electrical Review, subsequent articles appearing in the Aug. 7, Aug. 21, Sept. 4, Sept. 18, Oct. 2, Oct. 16, Nov. 6, Nov. 20, Dec. 4, Dec. 18, Jan. 8 and Jan. 22 issues.

Using formulas developed in a previous article we have

$$D = Kk \times G \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

where D is the dielectric flux density, G is the potential gradient, and K is the specific capacity of air, or farads per centimeter cube, with the numerical value 8.84×10^{-14}

The equipotential surfaces will be cylinders, and the flux density over the surface of any cylinder of radius x and of unit length, say 1 cm., will be $D = \psi/2\pi x$.

By formula (1) the potential gradient is

$$G = \frac{D}{Kk} = \frac{\psi}{2\pi x K k} \quad \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

In order to express this relation in terms of the total voltage E it is necessary to substitute for the symbol ψ its equivalent, $E \times C$, and calculate the capacity C of the condenser formed by the rod and the concentric tube. Considering a number of concentric shells in series, the elastance* may be written as follows:

$$\frac{1}{C} = \int_r^R \frac{dx}{2\pi x K k} = \frac{1}{2\pi K k} \log_\epsilon \frac{R}{r} \quad \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

Substituting in (2), we have

$$G = \frac{E}{x \log_\epsilon \frac{R}{r}} \text{ volts per cm.} \quad \ldots\ldots (4)$$

the maximum value of which is at the surface of the inner conductor, where

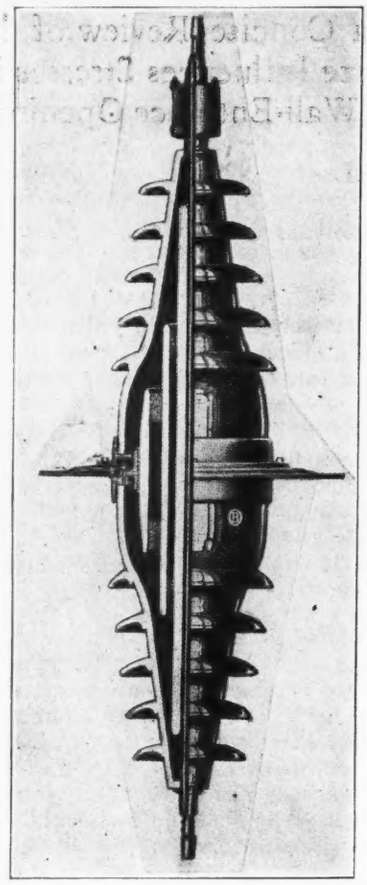
$$G_{max.} = \frac{E}{r \log_\epsilon \frac{R}{r}} \quad \ldots\ldots\ldots\ldots\ldots\ldots (5)$$

This formula is of some value in determining the thickness of insulation necessary to avoid overstressing the dielectric, but it is not strictly applicable to wall bushings in which the outer metal surface is short as compared with the diameter of the opening. The advantage of having a fairly large value for r is indicated by formula (5), and a good arrangement is to use a hollow tube for the conductor inside the bushing.

For a given voltage and constant diameter over

*The reciprocal of permittance or capacity.

the insulation there is a definite diameter of the core which will cause the potential gradient at the conductor surface to be a minimum. A small core will allow of a greater thickness of insulation; but, on the other hand, the smaller radius of curvature will tend to increase the stress, while



150,000-Volt Oil-Filled, Roof-Type Bushing.

the effect of too large a diameter of core is also to cause an increase in the stress through reduction of the total thickness of insulation. Formula (5) may be written

$$r \log_\epsilon \left(\frac{R}{r}\right) = \frac{E}{G_{\max.}}$$

and if we assume both R and G to be constant the greatest maximum permissible voltage E will be obtained when the quantity $r \log_\epsilon \left(\frac{R}{r}\right)$ is a maximum, a condition which is satisfied when $\log_\epsilon \left(\frac{R}{r}\right) = 1$, or $R = 2.718r$. Assuming this ideal requirement to be fulfilled, even if the inner core has to be made hollow in order to economize conductor material, we obtain the relation

$$r = \frac{E}{G} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (6)$$

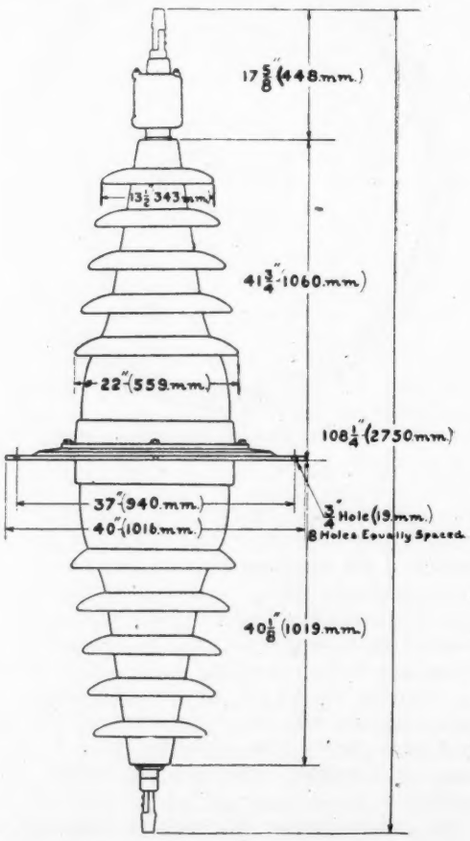
for the most economical conductor diameter, or rather for the conductor diameter which will require the smallest outside diameter of bushing.

Solid porcelain bushings with either smooth or corrugated surfaces may be used for any pressure up to about 40,000 volts. In designing plain porcelain bushings it is important to see that the potential gradient in the air space between the metal rod and the insulator is not liable to cause brush discharge, as this would lead to chemical action and the formation of a green deposit of copper nitrate upon the rod.

Oil-Filled Bushings for High-Tension Conductors.

The brush discharge between the rod at high potential and the inside surface of an insulating cylinder, when there is an air space between the two, is due largely to the difference in the dielectric constants of the solid insulation and of air. The conditions which will cause corona or brush discharge may be remedied by filling the space referred to with oil or some insulating compound which will eliminate all air pockets and, preferably, have the same dielectric constant as the solid bushing.

In the oil-filled bushing of the usual type a hollow shell of porcelain of sufficient length to prevent flash-over and provided, if necessary, on the outside, with sheds to give ample surface dis-



150,000-Volt Porcelain Roof Insulator.

tance, even under wet conditions, is filled with an insulating oil.

The diameter at the center of such a bushing must be such that the disruptive gradient, as calculated by means of the formulas previously developed, shall not cause break-down of the oil

near the surface of the conductor. Sometimes concentric tubes of solid insulating material with oil-filled spaces between them are placed in the space between the conductor and the outside insulating shell. These prevent the accumulation of conducting particles in the oil along the lines of stress and afford increased protection at small increase of cost.

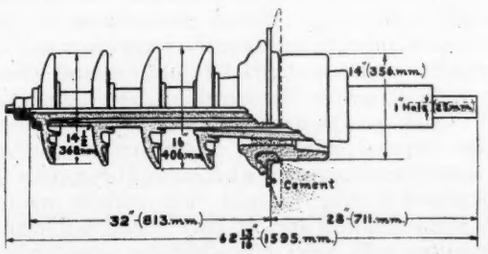
The fact that every bushing acts as a condenser or series of condensers between wire and ground must steadily be recognized just as in the case of the pole-line insulators, except that the effect is even more marked in connection with bushings entirely surrounding the conductor than with insulators that support the wire at one end only. When the climate and weather conditions are favorable it is well to avoid bushings entirely. In such cases the wires cannot be brought down through the roof of the building, but must enter at the side, a suitable protecting hood or roof being placed above the wires on the outside of the building.

The smallest dimension of the opening in a brick, stone, or concrete wall should preferably be not less than the values given in an accompanying table. On each side of the wall opening the conductor is carried by line insulators of the pin or suspension type, as the voltage may require, these being so arranged as to maintain the conductor in the center of the opening with a slight downward incline toward the outside of the building to prevent raindrops being carried to the inside.

OPENINGS IN WALLS FOR PASSAGE OF HIGH-VOLTAGE LINES.

Line pressure in volts.	Diameter of opening in feet.
22,000	1.50
33,000	1.75
44,000	2.25
66,000	3.50
88,000	4.75
110,000	6.00

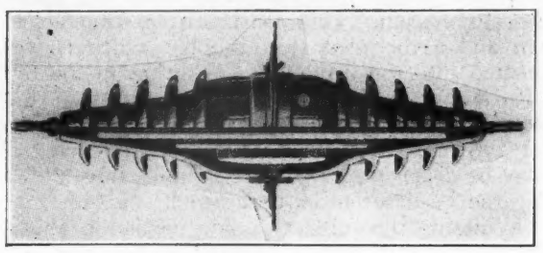
The condenser type of high-tension bushing is less used for carrying line conductors through the roofs or walls of buildings than as transformer or switch terminals, but it has some excellent features which may be briefly mentioned. By separating thin concentric layers of insulating material by tubes of tinfoil or other metal, and so proportioning the lengths of the tinfoil tubes that the areas remain the same, notwithstanding the variations in diameter, it is possible



110,000-Volt O-B Porcelain Wall or Roof Insulator.

to design a bushing which virtually consists of a number of condensers of equal capacity all connected in series. In this manner the potential gradient can be made uniform throughout the thickness of the insulating bushing. The design of such bushings is not quite so simple a matter as this brief reference to the main principle involved might suggest, but the commercial insulators of this class have, on the whole, given good service.

The tendency to equalize the potential gradient throughout the concentric layers of insulating



150,000-Volt Oil-Filled, Wall-Type Bushing.

material leads to a bushing of smaller overall diameter than when no attempt is made to equalize the stresses.

Special Points in Manufacture of Porcelain Insulators.

Porcelain used in the manufacture of line insulators is essentially a mixture of white burning clay, flint and feldspar reduced to a condition of extreme fineness and worked or pressed, when mixed with water, into the desired shape and then dried. In what is known as the "dry" process the plastic clay is nearly dried, then ground into the form of a damp powder and pressed into shape by steel dies. The specific gravity of insulator porcelain is between 2.5 and 2.7, and the dielectric constant is usually between 4.5 and 5.5.

The cement used in assembling the metal and porcelain parts of line insulators is almost invariably a good grade of Portland cement which should be used as soon as possible after mixing. Some manufacturers make a practice of placing all suspension-type units, after cementing, in special steam chambers where the conditions are favorable for the setting of the cement. It is generally considered advisable to design the parts so that only a small amount of cement is used in the joints; at the same time it is important to allow sufficient space to insure the free running of the cement and avoid air spaces.

In order to avoid dangerous stresses due to unequal expansion of the metal cap and porcelain the Ohio Brass Co. provides an elastic joint by sanding the coated surfaces of the porcelain. It is claimed that the sand grains, having a very much reduced area in comparison with the pocelain body to which they are attached, will take up practically all the distortion thereby relieving the main body of serious stress. The Lapp Insulator Co. uses a special elastic nonhardening paint to absorb the unequal expansion of the parts that are cemented together.

Wood and Metal Pins for Line Insulators.

Threaded wood pins are frequently used with pin-type insulators on the lower voltage systems. Locust wood is an approved material, and sometimes the pins are treated by immersion in hot linseed oil or paraffine. Forged-steel pins are recommended for the more important and higher voltage lines, or steel pins with threaded wood thimbles to screw into the porcelain. This type

of pin is frequently supplied with a cast-iron or porcelain base slipped over the steel bolt. The porcelain base increases the arc-over voltage of the insulator. The Hi-Voltage Equipment Co. of Cleveland, O., has lately put on the market a special design which securely locks the insulator to the pin. This consists of a forged-steel pin and a threaded steel thimble which is cemented into the insulator. A spring in the top of the pin holds a steel key engaged in the notches of the special thimble; but by pulling the key down against the pressure of the spring it may be disengaged from the thimble, thus allowing the insulator to be unscrewed.

While on the subject of line insulation a few words on the distance of separation between conductors on overhead lines will not be out of place. It is difficult to lay down rules for the proper spacing of overhead conductors. The question has been settled in the past by the individual engineer who has usually striven to be on the safe side in the matter of possible discharges between wires under abnormal conditions such as strong and variable winds. The result is that great differences are to be found in the wire spacings in different countries or on different transmission systems in the same country.

Spacing of the conductors should be determined by considerations partly electrical and partly mechanical. With the longer spans the spacing should be greater than with short spans, apart from voltage considerations. The material and diameter of the conductors should also be taken into account when deciding upon the spacing, because a small wire—especially if of aluminum—having a small weight relatively to the area presented to a cross wind will swing out of the vertical plane farther than a conductor of large cross-section. Usually wires will swing synchronously in a wind, but with long spans and small wires there is always the possibility of the wires swinging nonsynchronously, and the size of wire together with the maximum sag at the center of the span are factors which should be taken into account in determining the distance apart at which they should be strung. A horizontal separation equal to something between one and one and one-half times the sag at the temperature corresponding to the season of highest wind velocities should be sufficient to prevent wires swinging within sparking distance of each other, the closer spacing being used with copper conductors of large diameter.

Figures given in the accompanying table give spacing which are generally in accordance with present-day practice and indicate the desirable horizontal clearance between conductors. The vertical spacing may be somewhat less, but it is well to avoid stringing wires in the same vertical plane, especially where sleet and ice deposits may cause unequal sag and so perhaps bring two conductors close together.

The proper factor of safety to cover abnormal pressure rises is a matter of great importance since it is obviously bad engineering to provide insulation in excess of what experience has shown to be a reasonable safeguard against interruption of service. Generally speaking, insulators, when dry, should withstand a pressure test of two and one-half to three times the working pressure to ground, applied for 5 min., and a wet test of not less than twice the working pressure. This would sometimes be considered too small a margin of safety, but the ratio between test pressure and working pressure will depend upon whether the line voltage is high or low. It is clear that on the coast, where gales and salt-sea mists are prevalent, the factor of safety should be rather higher than in a district where the climatic conditions are more favorable.

As the wet or "rain" test will give different results, depending on the method of conducting the tests, there should be a clear understanding between the purchaser and manufacturer on this point. The method of attaching the test wire and ground connection to the insulator should be clearly defined. The test pressure is usually measured by means of a spark gap, and the alternating e.m.f. used should conform as nearly as possible to the sine wave.

Insulators on a transmission line erected at high altitudes will flash over with a lower voltage than if the line were erected at sea level. The reason for this is the reduced air pressure at the higher elevation. The flash-over voltage will not be exactly proportional to the barometric pressure because the electrostatic field is not uniform, but depends upon the type and design of the insulator.

The subject of line insulation will be concluded in a future article in which reference will be made to the troubles that have been experienced with porcelain line insulators and the means by which they are being overcome.

APPROXIMATE SPACING REQUIRED BETWEEN OVERHEAD CONDUCTORS FOR DIFFERENT LINE VOLTAGES AND LENGTHS OF SPAN.

	Span in feet.			
Line pressure between wires.	200	400	600	800
	Spacing between wires in inches.			
22,000 volts	32	52	...	...
33,000 volts	40	60	78	...
44,000 volts	48	64	82	...
66,000 volts	62	80	96	112
88,000 volts	78	94	110	126
110,000 volts	98	112	128	142
130,000 volts	118	130	142	156

ACTIVITIES OF A. M. OF E. S. ARE OUTLINED IN BOOKLET.

The Associated Manufacturers of Electrical Supplies has issued bulletin No. 25, in which is set forth briefly the objects, aims, activities and accomplishments of the association since its organization in 1915. It also gives names of past presidents, officers and board of governors. The pamphlet contains much of interest and shows the wide scope of the work of the association and the many activities considered by its sections.

The general standards committee of the Associated Manufacturers of Electrical Supplies has considered within the past year various matters of standardization and its library and publication committee will soon publish these standards in regular form to all members of the association.

The annual meeting of the association will be held on March 15, 1921, at the offices of the association, 30 East 42d street, New York City. In addition to the regular business, there will be an election of five governors to take the place of retiring members of the board whose terms expire by limitation.

Re-inspection of Old Electrical Construction Work

Altered, Damaged or Defective Installations Require Inspection and Renewals—Increased Safety Warrants Care in Supervision of Work — Paper Before Western Society of Electrical Inspectors

By BEN W. CLARK

Chief Electrical Inspector, Building Department, Detroit.

The importance of periodical inspection of old electrical installations, particularly in cities where the population is 25,000 or more, has never been criticized with any degree of success. It may be said that it is as important as inspection of wiring during progress of installation; indeed, some electrical inspectors claim it is of more importance. That, however, has not, except in few instances, been shown and is not at the present time accepted as wholly true. Nevertheless such inspection, when systematically conducted, is of vital importance and it is the purpose of this paper to attempt to prove this statement, while presenting for your consideration a system that has proven successful in Detroit.

National statistics concerning causes of fire list such items as fuses reinforced, overfusing, defective lamp cords, flatirons not turned off when not in use, impaired insulation, improper use of common lamp cords and many others; all of these being included under the time-worn erroneous heading of "defective wiring." Expert investigation of fire causes reported to have been of electrical origin have proved in many cases that the fire originated at some distance from any electric light or power wires. This brings to mind many instances where the cause was given as "defective wiring" by persons who had little or no experience in investigation of fire cause.

Re-inspection of old electrical installations, when instituted, should be conducted systematically to be a real benefit to the city. Experience has taught us to begin these inspections in the congested sections and gradually extend them to the more thinly populated districts. An acceptable plan is to cover one square completely, and proceed in this manner throughout the city, repeating the inspection in a period of about 1 month to see that defects have been corrected. Every square can be covered in from 3 days to 1 week, depending on the size of buildings, care given to the apparatus and wiring and the gaining of access to various sections of buildings.

Method of Compiling Inspection Reports and Records.

Considering an average of 5 days per square, we have five squares inspected in 25 days or 1 month. It now becomes necessary to repeat, beginning at the first square and continuing until the five squares have been re-inspected. With ordinary co-operation from the owner and tenant the sections rechecked should require only about one-half the time originally required, or about 12 days, which would bring about an improved condition in electrical installation within five squares in 1½ months. In most cases this would mean a much safer situation in electrical conditions within the districts covered.

The record-keeping, which is of vital importance, may be outlined as follows: Cards of any standard filing-cabinet size should be carried by the inspector on which he writes his reports. These are brought to the office every morning and defects copied from them on re-inspection letters, a copy of which is mailed to the owner and to the occupant, with one copy filed in the office, re-inspection cards being returned to the inspector's file for follow-up purposes. Instructions should be given by the inspector at the time of inspection and attention also called by the letter to report the name of the electrician making necessary repairs so as to keep the records complete.

The above is a general outline for a systematic re-inspection of old electrical installations, but may be changed to suit local conditions as, for instance, there may be sections of the city rather distant from the center which may require immediate surveys due to the character of the wiring.

In the re-inspection of old equipments the municipal inspector has somewhat an advantage over the Bureau inspector in having an ordinance or regulation to sustain his findings and enforce repairs to defective parts, and where the ordinance or regulations are enforced. Credit is due the National Board of Fire Underwriters whose engineers make periodic surveys in most cities, which proves the importance of re-inspection, as, for example, systematic re-inspection of old equipments was started in 1911 in Detroit and carried on at frequent periods since that date. A perusal of the reports of these periodic surveys will show a decided improvement in conditions.

No Hazard Involved in Use of Properly Installed Equipment.

It is essential to consider the expense attached to re-inspection from which there would be a very small revenue, generally speaking, but when we also consider the expense of one fire in the congested section of the city which might have been averted by re-inspection, saying nothing of the consequent suffering, we cannot but urge the necessity for re-inspection of old electrical installations. It is true that a small percentage of fires are caused from defective, or rather impaired, electrical apparatus and wiring, but this percentage seems to be gradually increasing, and

it behooves the large cities particularly to exert every means within their power to minimize this hazard.

Electrical apparatus and wiring when properly installed, that is, installed in strict accordance with adopted rules, is not a hazard, but when irresponsible persons are allowed to make additions to and changes in a safe electrical installation, and are allowed to replace fuses when blown, an absolutely safe installation may become dangerous to persons and property.

Common twisted lamp cord, experience shows, is one of, if not the greatest, electrical products used in a careless manner. It is frequently found on re-inspection that lamp cord is fastened to baseboard, over door and window frames and along the top of picture molding with ordinary double-pointed tacks that are not insulated. It is also found drawn across floors, under carpets and rugs, and lying over carpets and rugs. Furthermore, this cord is found fastened at the baseboard with bare metal tacks, and carried up the wall to furnish current to mantle lights or brackets. It may be said, and truthfully, that lamp cord has been known to be used in similar conditions for years without causing trouble, but would anyone knowing the possible results, permit lamp cord to be used as above stated in his own home or office?

Again it may be said that the use of lamp cord is somewhat a matter of education, that we must educate the unknowing public, but think of the education the public has had, is having, and will, we trust, continue to have in regard to safely crossing our streets. We, all of us, are taught when crossing a street, to look first to the left and when in the center of the street to look to the right; that is, always to look in the direction from which traffic is approaching. Our daily papers show that this education is a long story; some pay attention and some pay the penalty for inattention, and cities are compelled to enforce traffic regulations for the sole purpose of reducing the hazard. So it is imperative for cities to adopt regulations and enforce them to increase the safety of electrical installations, and the only correct method of accomplishing this is by a systematic re-inspection of old equipments.

By this it is not inferred that all old installations should be changed to comply with the rules in force at the time of re-inspection; such action on the part of the department having charge would be entirely unnecessary. Our success, to a great extent, is due undoubtedly to the method employed, which is to bring the old installations up to reasonably safe standard, this standard to be approved by the department head.

Application of Re-inspection System to Detroit Industries.

Another important application of re-inspection which has been in operation in Detroit for more than 6 years is a systematic follow-up of new and old work in manufacturing plants, styled "Industrial Re-inspection." This branch when started was operated at a loss, considering fees paid for inspection, which was due to the fact that our industrial companies understood they were immune from inspection after the original installation, and, consequently, until our intention was understood and their co-operation secured, a complete survey of each installation became necessary and this was checked against the original inspection. This, as can be readily seen, consumed considerable time and consequently brought small returns, but, beginning with the second year, this branch of the work has been self-sustaining, due to complete co-operation between the electrical inspection department and the industrial manufacturers. In this phase of inspection personal safety is considered almost paramount, the fire hazard being reduced by the construction of the building.

Since 1911 more than 12,000 old electrical installations have been changed to improve conditions. In addition to this every industrial plant has been inspected at least 10 times, also all of our schools and dance halls have been similarly re-inspected in the period from March 25, 1911, to January, 1921.

One inspector is detailed for industrial re-inspection, the work of re-inspection of other buildings throughout the city is being at present performed by the district inspectors. Prior to 1911 inspections of old work were made wherever additional wiring was installed, and at the same time reports were sent to the owner and occupant as aforesaid. Referring again to industrial re-inspection, the co-operation from our manufacturers is so marked that no changes are made or work installed without a regular inspector being called. In conclusion, it is hoped that the statement made in the introduction has been proven, and a thought impressed as to this very important factor of electrical inspection; "systematic re-inspection of old equipments."

HYDROELECTRIC PROJECT PLANNED ON DELAWARE RIVER.

Corporation to Be Organized to Construct Steam and Hydroelectric Plants to Supply Power in Delaware Valley District.

Paul T. Brady, 165 Broadway, New York City, and associates, are planning the construction of a number of hydroelectric power plants on the Delaware river. Application has been made to the Federal Power Commission, Washington, D. C., to utilize the waters for this purpose. Power rights at different points have been secured, and it is proposed to organize a corporation to take over these rights and construct the stations. The central generating plant will be located in the vicinity of Belvidere, N. J., designed to have an ultimate capacity of about 300,000 hp. This plant will be supplemented by 12 other generating stations, both hydroelectric and steam, all tied in with one high-power transmission system. The different plants will be located at such points as Hankins, Narrowsburg, Barryville, Mongaup, and Eastbranch, N. Y.; Dingman's Ferry and Bushhill, Pa.; and points in New Jersey, all places being in the Delaware valley district.

The transmission system will comprise a steel tower line. It is planned to build five large reservoirs for impounding waters, to include an artificial lake, extending from the Delaware Water Gap to Belvidere, about 20 mi.

EDITORIAL COMMENT

Financing Central-Station Expansion

There is much interest in all branches of public utility development, accentuated at this time because of unavoidable delay to the customer in securing increased or new facilities and equipment. The lack of material and of skilled men was particularly noticeable for many months, but these handicaps are being removed fairly rapidly now. To secure the money to properly make extensions has been the acute problem all along the frontier of new endeavor, and in no one field has this been more the case than in central-station operation and expansion. This is largely true because of the larger demands, and perhaps very much due to the fact that both large and small investors have never fully realized the absolute necessity of electric service for light and power in today's growing life. They have never been told, have never been educated to grasp the facts at the bottom of all public-utility contemporaneous growth—that if the companies are to supply service and material the patron today must do his share by assisting in financing where additional funds are needed. And these are days when such investments are safe and sound. Enlightened legislation in many states—and more is to follow—has wiped out for all time the possibility of "watered" stock and the over-issues of bonds, and the earnest operators of these utilities gladly co-operate with state commissions in observing the rights of the public as well as securing stability and proper return for the investor.

The greatest asset today possessed by the central-station management that strives to keep up with the demand, as they all do, is the real and bona-fide need of every community for their product—electric service—and the quicker the various users become the general investors, just so much sooner will the central-station companies be able to give the service called for, and on a safe basis and with satisfying results.

False Premises

The National Board of Fire Underwriters recently made public a compilation of fire losses for the years 1915 to 1919, inclusive, which has been seized upon quite erroneously by some of the daily papers as being a basis upon which to establish the various causes for the unusually high fire loss in the United States. The presentation of figures culled from the report have in the main been eminently unfair to the electrical industry, for quite undue emphasis has been placed on the reputed $84,086,471 loss by fires of electrical origin as the *chief* factor in the claimed total fire loss of $1,416,375,000. These sums are so vast and so much emphasis has been placed on the property waste by fires of electrical origin that the fact is apparently lost sight of that eighty-four odd million constitute less than 6% of the aggregate fire loss claimed. Great as undoubtedly has been the property loss occasioned by fires attributable to the use of electricity, even the figures of the Underwriters indicate that less than one out of every 16 destructive fires can by any stretch of the imagination be charged to electrical causes—a proportion which is quite considerably less than has heretofore been claimed.

Painstaking investigation into the causes of fires during the year 1919, conducted by the Society for Electrical Development, however, reveals the fact that the inferences made as to causes of fires by the Underwriters' report are very far from being dependable or even indicative of the relative dangers from various fire hazards. Reports submitted by fire chiefs, department, municipal and state officials, central-station records and statements for special commissions, place as the proportion of fires in residences and commercial buildings in any way traceable to the use or abuse of electricity, 2.57% of the total number of fires in the communities reporting. The reports came from 345 towns and cities of 5000 or more population—an aggregate of 28,495,851 people, or a very large proportion of the country supplied with electric service in 1919—and in far the greater number of cases the percentage of fires of electrical origin was materially less than this mean value.

In the case of fires due to carelessness with matches and in smoking, ranking second in the Underwriters' compilation with a reputed loss of $73,474,248, even greater discrepancy with the reports filed with the Society for Electrical Development is found. Those cities which submitted reports detailing fires caused by matches give an average percentage of nearly 7.5 of all fires as due to such cause, or nearly three times as many fires from this common and serious hazard as can be charged to the use of electricity—not fewer, as inferred by the compilations of the National Board of Fire Underwriters.

The very marked discrepancies between the in-

ferences of the National Board of Fire Underwriters and the findings of the Society for Electrical Development are explained by the methods employed in compiling statistics by the two bodies. The compilations of the National Board of Fire Underwriters are based on the adjustment of 3,500,000 insurance claims, to which is added an arbitrary 25% to cover unrecorded burnings and the destruction of uninsured property. The figures of the S. E. D. cover all fires, whether the property destroyed was insured or not, and are the actual calls upon the services of the fire departments of the various communities. Furthermore, the fire records as submitted by the fire departments were checked so far as possible by the private records of central stations, municipal and state officials, findings of commissions, expert investigations and other available sources of authentic records.

Particularly striking as the difference is in the careless use of matches and in discarding lighted cigarette and cigar stub hazard, it may also be explained in part by the fact that much private property is destroyed or perhaps only slightly damaged by fires of such origin for which the owners never make claim for insurance, appreciating that the loss is due to their own carelessness. The fire department frequently responds to fire calls of such character and so are cognizant of the burnings, while the owner of the property having no claim for damages makes none and the fires are not recorded with the Underwriters.

Even the first reports from fire departments cannot always be relied upon for supplying accurate information as to the cause of fires. A case in point is that of one of the largest cities on the Atlantic seaboard. The first report submitted gave 152 fires of electrical origin, or 3.52% of all the fires recorded for 1919. Further investigation cut the number of fires attributable to the use of electricity to 64 (1.48%) and finally, by continued search it was found that the number was only 38, or 0.88% of the total number of fires.

Many other instances could be cited in which thorough investigation very materially reduced the number of fires attributed originally to electrical origin, and there are many towns of fair size in which fires were as prevalent as in others, but none of which were attributable to the use of electricity. Cities of large size were in some cases notably free from fires of electrical origin despite the fact that electricity for lighting and household appliances are in very general use. For example, Chicago, where it is claimed that electricity is more extensively used than in any other large city, had for 1919 a record of less than two-thirds of 1% of all fires attributable to the use of electricity. St. Louis had a record of only $.54%. Other cities show proportionate records.

Corona as a "Safety Valve" on Overhead Systems

The energy dissipated in the air by the corona which forms on overhead transmission lines at high pressures is proportional to the square of the excess of pressure over what is known as the disruptive critical voltage. It follows that a comparatively small increase in pressure on a line operating at or near the voltage at which corona appears may lead to a considerable increase in the amount of energy dissipated in the air. As an example, it is said that on the system of the Grand Rapids-Muskegon Power Co. the line loss due to corona discharge does actually increase 100% for an increase in line pressure amounting to only 10%. It does not, however, follow that the relief afforded by corona to locally impressed extra-high voltage disturbances, due to atmospheric conditions or internal causes such as switching operations, will be dissipated successfully by corona, because these disturbances, being local, accumulate energy locally which must be dissipated before the disturbance can travel far along the line, and evidently the dissipation of a large amount of suddenly impressed energy over a short section of a transmission line by corona discharge is not possible.

A suggestion recently made by R. Nagel to utilize the discharge to the air as a protection against surges is worthy of consideration. He points out that if the transmission-line wires were provided with a large number of sharp points, the discharge would take place far more readily, and adequate protection might be afforded in many instances of suddenly impressed high voltages. He believes that the commercial galvanized barbed wire might be used with advantages to provide the sharp points referred to.

Tests have been carried out to determine the effectiveness of this kind of protection. A transmission line consisting entirely of barbed wire would probably afford good protection, but there are many objections to such a line. Mr. Nagel believes that short lengths of barbed wire inserted in the transmission line in the neighborhood of generating and substations would be sufficient to afford a reasonable degree of protection. It is also suggested that at high altitudes or on such sections of the line where atmospheric conditions are known to cause trouble, comparatively short stretches of barbed wire might be used in place of the smooth surface conductors.

Optimism in 1921 is determination to wire as many as possible of the millions of unwired buildings in the United States and preparation to wire all of the new buildings constructed throughout the entire year.

THE WEEK'S NEWS

Reports of Important Meetings, Developments and Other Happenings of the Electrical Industry and Its Allied Interests

UTILITY INFORMATION COMMITTEE FORMED IN MICHIGAN

Committee Indorsed by Michigan Section N. E. L. A., and Michigan Gas Association—Headquarters Established at Ann Arbor, Mich.

The matter of establishing a committee on public-utility information was indorsed by the Michigan Section of the National Electric Light Association at its convention held at Ottawa Beach in August last. As the result of such action a committee has been organized with the following members: H. W. Douglas, chairman; J. W. Batten, George E. Lewis, C. W. Tippy, A. C. Marshall, E. Holcomb, C. G. Bennett and F. A. Newton. The headquarters of the committee will be in Ann Arbor, Mich. Henry H. Tinkham, an experienced newspaper man, will be the director. H. Silvester, Detroit Edison Co., at Ann Arbor, will serve as secretary of the committee.

The Michigan Committee on Public Utility Information will be representative of all the electric and gas utilities in the state. It will be under the auspices of the Michigan Electric Association and the Michigan Gas Association, having been approved by these associations. The committee will conduct a campaign of information based on the following general principles: (1) to deal only in accurate and provable facts; (2) to avoid all local controversies and political issues, and (3) to acquaint the public with the problems peculiar to public-utility operation and management.

ELECTRIC MARINE POWER TOPIC OF ENGINEERS' MEETING.

Addresses Before New York Sections of A. I. E. E. and A. S. M. E. Cover Electric Propulsion of Steamships and Related Subjects.

Electric power in navy and merchant marine was the main topic discussed at a joint meeting of the New York Section, American Institute of Electrical Engineers, and the Metropolitan Section, American Society of Mechanical Engineers, Jan. 28, in the Engineering Societies building, New York City. The occasion was termed "Marine Electrification Night," the chairman being Alfred E. Waller, of the marine committee, A. I. E. E., and chief engineer of the Ward-Leonard Electric Co. Mr. Waller briefly outlined the goal in merchant marine construction and design toward which American engineers were striving.

Admiral W. S. Benson, chairman of the United States Shipping Board, compared the past and present naval ship personnels and the great difference in horsepower of early marine engines and the modern types. He called attention to the development of oil as a fuel in recent years and regarded it as the solution of future problems, believing that eventually there would be developed an efficient internal-combustion engine which would generate the electricity needed for the ship's propulsion. The navy had been backward in introducing electrical power, but it fully realized that the problems requiring immediate consideration were reduction of ship operating expenses and the economy of space, particularly in merchant vessels.

The paper of H. L. Hibbard, manager of the marine department, Cutler-Hammer Manufacturing Co., on "Electricity Applied to Ship Auxiliaries," showed the growth and adoption of electric power for auxiliary purposes and stated that in selecting a generating plant for electrically operated ships the aim is in general to provide an equipment which is sufficiently flexible to permit of operating all auxiliaries and the lights with one machine when cruising, and to operate the vessels while handling cargo in port with two machines. Direct current has a distinct and decided advantage in the flexibility and extent of speed control obtainable and in the obtaining of speed and torque characteristics for hoisting apparatus. Mr. Hibbard said that the adoption of electric drive is now receiving impetus from the introduction of the fuel-oil engine and its general use may be looked for at an early date. In discussing this paper Maxwell W. Day, marine department, General Electric Co., stated that the use of electric auxiliaries on motorships would result in its adoption on steamships since a generally overlooked advantage is the ease with which the amount of power required may be measured. Only marine electrical apparatus should be used on shipboard, and not that designed for land service. J. C. Shaw, assistant to the chief engineer, Wm. Cramp & Sons Ship & Engine Building Co., stated the saving of the electric drive over steam was due primarily to the high efficiency of the former's auxiliaries.

Commander C. S. McDowell, United States Navy, and naval inspector of machinery, General Electric Co., gave a paper on "Electrical Terminal Facilities," which considered efficient cargo handling as the basis of an efficient merchant marine. The electric drive was shown to be the better for large naval vessels and fast passenger ships by Eskil Berg, engineer of the turbine department, General Electric Co., in presenting the subject of "Turbine Reduction Gears vs. Electric Propulsion for Ships," while the geared-turbine drive was advantageous for fast destroyers, light cruisers and slow-speed freighters, because it has less weight and is cheaper. For merchant ships the question of service, economy, reliability, weight and cost must be considered when deciding upon the type of propelling power to be used.

W. E. Thau, general engineer of the Westinghouse Electric & Manufacturing Co., read a paper

on "Electric Propulsion of Ships." After classifying the various types and arrangements of power drives, he enumerated the advantages of each with its modern application and concluded that the prime consideration is reliability, while economy, simplicity, cost, weight and space are important but secondary. The two general systems of electric propulsion are those in which the prime mover is the steam turbine or the Diesel engine. The advantages of the former for warships lie particularly in the flexibility of arrangement of the machinery with respect to its protection from torpedo attack and, secondarily, the availability of full backing power and flexibility of control. In the discussion of this paper, G. A. Pierce, electrical engineer of the Wm. Cramp & Sons Ship & Engine Building Co., called attention to the necessity of simplicity in the control and of the automatic indication to the chief engineer of the operation of switches, valves, etc. He said there was no need for full speed astern, as only one-third of full forward speed can be effectively used in retarding a vessel.

Commander C. A. Jones, United States Navy, regarded the reciprocating engine as unsuitable for the modern vessel of 6000 hp. It was his experience that the personnel for an electrically driven ship could be trained in a short time. By careful designing the geared drive can be built to compare favorably in both floor space and weight with the electric drive, was the belief of W. B. Flanders, marine engineer of the South Philadelphia works of the Westinghouse Electric & Manufacturing Co.

ARRANGING FOR SPECIAL TRAIN TO FIXTURE MARKET.

The Central West lighting fixture manufacturers have announced their intention of chartering a special train from Chicago to Buffalo for the accommodation of those in that section who plan to attend the convention of the National Council of Lighting Fixture Manufacturers and the second annual Fixture Market to be held in the Elmwood Music Hall, Buffalo, Feb. 14-19. Franz Brzeczkowski, president of Moran & Hastings Manufacturing Co., 16 West Washington street, Chicago, is chairman of the transportation committee having the matter in charge.

EXECUTIVE COMMITTEE, N. A. E. C. D., MEETS IN NEW YORK CITY.

Organization Formulates Plans to Study Overhead and Installation Costs—Personnel of Labor Committee Named for Current Year.

Plans were formulated for continuing the investigation of the cost of overhead and to study installation costs, at the recent executive committee meeting in New York City of the National Association of Electrical Contractor-Dealers. In connection with the latter a subcommittee was appointed to devise a standard cost-keeping system that would reveal reliable data on the subject and enable the cost of the installation of electrical equipment to be compared along lines similar to those of the cost-accounting system for merchandising.

The proposed revision of the standard symbols for wiring plans were discussed and the executive committee decided to have the association assist the engineering and architectural organizations in carrying out this work. The moral and active support of the society was pledged toward promoting a feeling of good-will to the public utilities, particularly the electric light and power companies.

James R. Strong, New York City, was elected national chairman for 1921; Thomas M. Templeton, Detroit; B. H. Bendheim, Chicago, and James R. Strong, committeemen at large. The labor committee which forms the National Labor Council will be composed this year of L. K. Comstock, New York City; A. J. Hixon, Boston; G. M. Sanborn, Indianapolis; Kenneth A. McIntyre, Toronto, and Robley S. Stearns, New Orleans.

INSPECTORS DISCUSS WIRING AND EQUIPMENT PROBLEMS.

Ventilation Urged for Heavy Conductors Inclosed in Ducts—Co-operation With Architects to Improve Wiring Installations.

The final meeting of the convention of Western Association of Electrical Inspectors held in Detroit, Jan. 25 to 27, opened with consideration of the report of the committee on outside wiring, read by L. D. Smith of Minneapolis, Minn. J. W. Kelly, Jr., Camden, N. J., called attention to the fact that metallic piping protecting ground wires must be connected to the ground conductor at both ends of the pipe. Mr. Smith stated that in Minneapolis the ground pipe was extended up the pole and connected to the ground wire beyond the point where it would be affected by mechanical injury. He also stated that experience had proven driven-pipe grounds to be ineffective in Minneapolis, several serious failures being reported in connection with their use.

Chairman Dana Pierce, of the electrical committee, asked if the National Electrical Code should in the opinion of inspectors be made to cover in its outside wiring rules comprehensive requirements for overhead construction. The general consensus of opinion seemed to be that it should not. In reply to a question as to how many cities were permitting secondaries to be connected to underground water pipe, W. P. Briggs, New Bedford, Mass., advised that his city had been permitting the practice since 1912. It was also brought out that the American Waterworks Association had ruled in favor of the connection of secondaries to underground water pipe systems. J. W. Kelly, Jr., informed the meeting that such practice had been followed in New Jersey for several years. The committee was continued, but was instructed to cover overhead lines which exposed buildings, the idea being that the general rules governing line construction should be incorporated in the National Electrical Safety Code. The value of weatherproof insulation on overhead wiring was questioned, except when in good condition and not exposed to excessive moisture.

The report of the committee on theater wiring recommended the use of steel cables for suspending borders because, in case of fire on the stage,

manilla rope would burn and drop the borders on the heads of firemen and others engaged in extinguishing the blaze. It was brought out that the building code of the National Board of Fire Underwriters requires the use of metal cables for supporting borders. Objection was raised to the specifications for limiting the size to ⅜-in. cable when in some cases this would not be sufficient and in others it would be an excessive requirement.

B. W. Clark, Detroit, called attention to the fact that borders supported by manilla ropes had been known to fall. F. A. Cambridge, Winnipeg, called attention to the fact that the new type of border designed for use in connection with the Type C lamp requires additional ventilating facilities, which means a heavier structure. Dana Pierce proposed the elimination of the insulating joint where cables and borders were properly grounded. After considerable discussion the meeting voted to recommend the elimination of link fuses in connection with plugging boxes because they have been found to be in poor condition after several months' service on the road.

At the conclusion of consideration of the report the mechanism of a dead-front switchboard of special design was exhibited by the Frank Adam Electric Co. A committee appointed to draft a resolution on the proper handling of auto-transformers reported the following resolution, which was adopted:

> Resolved: That the association records its recognition of certain serious hazards which are involved in the use of auto-transformers for the purpose of supplying a lower-voltage circuit.
>
> The association considers that such use of auto-transformers should either be forbidden or the condition of use so limited as to eliminate the hazard in question.
>
> The association further instructs its executive or other proper committee to present this matter to the National Electric Light Association, inviting full discussion and conference upon it to the end that the findings of such conference may be bulletined at an early date to the members.

In discussing the report of the committee on underground systems the wisdom of the recommendation to permit the intrenching of a duplex or two single conductors without the use of a raceway was questioned. In some territories it is demanded that the raceway be provided or the cable must be equipped with a proper armour protection. J. W. Kelly, Jr., urged care in the installation of underground raceways so that pronounced drainage would be established.

The wisdom of invariably requiring that rubber-covered wires be protected by a lead covering was questioned, since sometimes the drainage varies and the frost and ice forces the lead covering through the insulation, grounding the circuit. After some discussion, attention was called to the fact that the problem was an engineering one and did not involve a serious fire hazard. Objection was made to the low limit of 2500 volts for primary distribution. In connection with secondary distribution it was urged that the limit be raised to 440 volts. Attention was called to the importance of placing a heavy current-carrying conductor in ducts where ventilation would be most effective, keeping the neutral on the inside of the conduit system.

In connection with the report of the committee on architects' specifications it was decided to omit from the proposed letter or bulletin to architects any reference to excessive fire losses due to defective electrical conditions. It was pointed out that the letter as drafted would not always be suitable for every city. F. A. Cambridge informed the meeting that he had used such a letter in an effort to interest architects in better wiring, and that it had been a success. The letter was ordered printed for circulation to the association, and a resolution was adopted recommending that members use the letter in connection with campaigns to interest architects in better wiring specifications. The report of the committee on elevator wiring was adopted practically as presented.

N. Rousseau, in presenting the report of the committee on motor inclosures, distributed pamphlets containing specifications for and illustrations of motor inclosures equipped with a metallic ventilating system. In replying to the question as to what materials are considered as fireproof, the chairman named brick, tile, concrete and metal. Attention was called to the fact that some metallic inclosures are not dust tight, especially where excessive dust conditions prevail, and wherever possible under these conditions a special motor room should be provided.

The report of the committee on installation and operation of induction motors brought out an interesting discussion. The need for a table to cover a 4000-volt motor installation was suggested, and the fact was brought out that a separate room for high-voltage motors was more acceptable than a mere inclosure. Dana Pierce asked if the tables included in the report were in accordance with the code rules, and inquired how many cities were using the tables adopted by the Western Association of Electrical Inspectors. It was brought out that the tables had wide circulation and adoption, but that they were objectionable in certain particulars in certain cities.

In reply to a question as to what character of switch should be required for controlling an auto-starter, or a group of auto-starters, Mr. Pierce stated the Safety Conference had recommended that switches which could be opened under full load must be designed to operate successfully in breaking a current of 150% of the rated full-load current of the motors controlled, or if the switch was locked so as to prevent opening under load conditions it may be of the simple disconnect type. On motion the report of the committee was adopted for a year's trial in the field before final approval.

J. H. Fenton, in presenting the report of the committee on lighting fixtures and wiring, urged the members to follow the National Electrical Code closely and enforce its requirements when inspecting electric lighting fixtures.

In considering a report of the committee on farm lighting systems, it was brought out that plans were being perfected to arrange for the inspection of such installations either by representatives connected with the state fire marshal's office, insurance agents specially trained for this work, and inspectors associated with farm mutual fire insurance companies. It was urged that increased rates be demanded by insurance companies where unapproved plants are installed in or-

der to promote a more comprehensive system of inspection.

V. H. Tousley, of Chicago, urged the greater co-operation on the part of members in securing data for the committee on demand factor, and asked that the report be accepted as one of progress, and the committee continued.

Officers elected for the following year are as follows: President, J. H. Fenton, St. Louis Fire Prevention Bureau, St. Louis; first vice-president, O. M. Frykman, Building Department, city hall, Minneapolis, Minn.; second vice-president, F. O. Evertz, Ohio Inspection Bureau, Columbus, O., and secretary and treasurer, W. S. Boyd, Chicago. F. S. Anderson, Evanston, Ill., was elected chairman of the executive committee, and W. A. Haig, Milwaukee; J. S. Mahan, Chicago; L. A. Barley, Denver, Colo.; J. W. Strub, Toledo, O., and H. J. Clark, Oklahoma City, Okla., were elected members of the executive committee.

NATIONAL ELECTRICAL RULES SUBMITTED FOR APPROVAL.

The National Fire Protection Association has submitted to the American Engineering Standards Committee for approval as an American standard its "Regulations of the National Board of Fire Underwriters for Electric Wiring and Apparatus," edition of 1920, otherwise known as the National Electrical Code. This code is submitted in accordance with the special provisions in the procedure of the committee under which important codes in existence prior to 1920 may be approved without going through the regular process followed in new work. The committee would be glad to learn from those interested of the extent to which they make use of this code, and to receive any other information regarding the code in meeting the needs of the industry.

EXHIBITS ON DISPLAY AT MARINE SHOW IN NEW YORK.

Electric Ship Propulsion Machinery, Lighting Fixtures, Controlling Devices and Equipment Featured at Marine Exposition.

One phase of the marine industry which was well represented at the third National Marine Exposition at the Grand Central Palace, New York City, Jan. 26-29, was that of ship propulsion. The combined group-control and panel, with a miniature model of the electric ship-propulsion machinery on the S. S. *Eclipse,* was illustrated in the exhibit of the General Electric Co. In addition there was shown the uncovered turbine wheels of a 2500-hp. marine-geared turbine, the high-speed gear with shaft and one-half coupling, low-speed Quill type pinion, sprung-type thrust bearing and marine d-c. motors.

The Cutler-Hammer Manufacturing Co. displayed its controlling devices, and the B. F. Sturtevant Co., Boston, had an installation of a forced-draft generating set for heating and ventilation purposes. An installation of turbine feed pumps, vertical piston pumps and surface condensers featured the Worthington Pump & Machine Co.'s exhibit. The De Laval Steam Turbine Co. had on display its high and low pressure turbine rotors and high speed gear reduction unit of a 3500-hp. compound marine turbine and models of different capacity oil purifiers.

A "New Idea in Light" was the impression conveyed by the exhibit of the Pyle-National Co., Chicago, with its turbogenerators, marine lighting fixtures and search and floodlights, which showed the advantages of the generators in economy of operation, maintenance and installation space. A complete exhibit of insulators for 1000 to 1,000,000 volts was displayed by the Electrose Manufacturing Co., Brooklyn, N. Y.

The space of the Benjamin Electric Manufacturing Co. was devoted to a display of watertight marine electric fixtures and fittings, wiring devices and telltale panels. The Columbian Rope Co., Auburn, N. Y., showed reels of different kinds of rope and a panel illustrating how the various knots and splices known to the seafaring trade are made. The Babcock & Wilcox Co., New York City, had set up two full-size sectional views of marine steam boilers, one illustrating the design and construction of the "Alert" type, while the other demonstrated the "Express" or quick steamer type, both being fitted with coal and oil-burning equipment. A reproduction of its original and latest type of mechanical fuel-oil atomizers showed the recent development in this device.

A. S. M. E. DISCUSS MANUFACTURE OF STEEL PIPE.

The Ontario section of the American Society of Mechanical Engineers held a joint meeting with the Engineering Institute of Canada Feb. 2 at the King Edward Hotel, Toronto. F. N. Speller, National Tube Co., spoke on the "Effects of Corrosion on Steel Pipe and the Manufacture of Large Steel Pipe up to 96-in." The subject of "Wind Channel Intakes" was handled by J. H. Parkin, Jr.

WILL DISCUSS ELECTRIC RAILWAY FINANCING.

American Electric Railway Association to Hold Mid-Year Conference in Chicago—Prominent Speakers Will Address Delegates.

The mid-year conference and dinner of the American Electric Railway Association will be held at the Drake Hotel, Chicago, Feb. 10. The following papers will be presented: "Previous Methods of Electric Railway Finance," by James F. Fogarty, secretary of the North American Co., New York City; "Present Requirements for Mortgage Securities," by F. K. Shrader, Halsey, Stuart & Co., Chicago; "Home Town Financing—Partial Mutual Ownership," by S. B. Way, vice-president and general manager of the Milwaukee Electric Railway & Light Co.; "Necessity of Financing by Sale of Capital Shares," by Chester Coey, vice-president of the Harris Trust and Savings Bank, Chicago; "Municipal Aid in Electric Railway Financing," by Melvin A. Traylor, president of the First Trust and Savings Bank, Chicago, report of special committee on report of Federal Electric Railways Commission, and a re-

port of special committee on public utilities of the Chamber of Commerce of the United States.

At the dinner, Philip H. Gadsden, president of the American Electric Railway Association, will preside, and among the speakers will be John W. Weeks, former United States senator from Massachusetts; James H. Wilkerson, former chairman of the Public Utilities Commission of Illinois, and Charles A. Leedy.

CENTRAL STATIONS CO-OPERATE IN NATIONAL THRIFT WEEK.

The birthday of Benjamin Franklin was commemorated during National Thrift Week, Jan. 17-22, the occasion being taken advantage of by some of the central-station companies to tie this

Benjamin Franklin Would Recommend Sound Electrical Investments

FRANKLIN, whose birthday January 17, is being commemorated by National Thrift Week, was one of a few men who founded the United States of America. We owe him the deepest gratitude.

You will recall that Franklin foresaw the wonders of electricity and that he was a great advocate of personal thrift.

In Franklin's time electricity and thrift could not be linked together and made to work hand in hand for the comfort and happiness of men and women. Today we find an extraordinary union of two subjects to which his wisdom devoted much attention.

Who can doubt that this great pioneer in electricity, if alive today would advocate the acquirement of financial independence by the people, by their saving and investing in organizations serving mankind with an ever-increasing supply of electrical energy?

All wisdom does not come from the past, but when the words and deeds of a man live through the centuries, his advice is worth heeding.

Our 7% Preferred Stock affords an ideal opportunity for you to carry out the thrift ideas of Franklin and to further develop the great forces of electrical energy which his investigations helped to bring to us.

Union Light, Heat & Power Co.

610-612 N. P. Avenue—Fargo, N. D.

Ask for our illustrated, descriptive literature.

Advertisement Used by Union Light, Heat & Power Co. During National Thrift Week.

movement up effectually with their customer-ownership plan by offering the public an opportunity to invest their savings in organizations serving mankind with an ever-increasing supply of electrical energy. The advertisement of the Union, Light, Heat & Power Co., Fargo, N. D., lays stress on the thrift ideas of Franklin, the great pioneer in electricity, and points out that by investing in the securities offered, the public will be lending its assistance in further developing the great forces of electrical energy which Franklin's investigations helped to bring to the present generation.

CONTRACTOR-DEALERS HOLD MEETING IN BOSTON.

The Massachusetts State Association of Electrical Contractors and Dealers held a meeting Jan. 26. The officers of the association are: Chairman, George B. Quinby; treasurer, Frank L. Barnes, and secretary, J. E. Wilson, all of Boston. On the same date the Boston district of the association held a conference, R. R. Ringer being made chairman and J. E. Wilson, secretary and treasurer.

CO-OPERATIVE MEETINGS ENTHUSE CONTRACTOR-DEALERS.

Special Representative Davis, National Association of Electrical Contractors and Dealers, Holds Cross-Continent Conferences.

In connection with the co-operative work being conducted by the National Association of Electrical Contractors and Dealers, Laurence W. Davis, special representative of the organization, who is on a 9000-mi. trip covering a large part of the West, has held meetings in Omaha and Lincoln, Neb., Denver and Colorado Springs, Colo., Butte, Mont., and Spokane, Wash., during the two weeks from Jan. 10-24. At Omaha he addressed the Electrical Industries Club Jan. 11, and that same evening about 40 men turned out at the meeting of the Omaha Electrical Contractor-Dealers' Association to hear his message. Constructive co-operative work is making rapid strides at Omaha, and following this meeting many contractor-dealers decided to adopt the national association accounting system in their business.

Three meetings were held in Colorado, two in Denver Jan. 13-14, and one in Colorado Springs Jan. 17. As a result of these meetings the Colorado association has increased its membership, and the determination was expressed to try and make the state membership 100% during this year.

Mr. Davis spoke before the Sale Lake City association on the evening of Jan. 19, which resulted in the local membership joining the national association. It was decided to extend the movement throughout Utah by a series of meetings in other cities.

The Montana state association, which was formed last year, had an opportunity at its Butte meeting, Jan. 22, of getting acquainted with the work of the national association, and agreed to unite the whole state membership with the national body. A state convention is planned for April 14-16 at Butte, with a roundup of all the Montana electrical interests, at which time representatives of the General Electric Co. and the Westinghouse Merchandising Bureau are expected to present a splendid educational program. The Butte men are interested in the efforts of the Idaho contractor-dealers to form a state organization, which will hold its first convention at Twin Falls, Ida., Feb. 20.

At the Spokane meeting about 50 men turned out to hear Mr. Davis, who urged the organization of a much-needed local association of contractors and dealers to function in co-operation with the Northwestern Service League's co-operative movement.

Mr. Davis' talks, which cover the practical everyday problems of the contractor-dealer, are illustrated with blackboard sketches on overhead, percentages, turnover, etc., and outline the constructive educational work which local associations can do under the new ideal of bettering

competition, rather than restricting it. Over 50 new members were added to the roster of the national association during the first two weeks of his trip. Further meetings are scheduled for all the Pacific Coast cities, with a return trip via Arizona, Texas, Louisiana, Alabama, Florida and the Atlantic states.

RADIO ENGINEERS ELECT OFFICERS FOR 1921.

The Institute of Radio Engineers elected the following officers for 1921: President, Ernst F. W. Alexanderson, chief engineer of the Radio Corp. of America; vice-president, Fulton Cutting, president of Cutting & Washington, Inc.; secretary, Alfred N. Goldsmith, professor of electrical engineering, City College of New York; treasurer, Warren F. Hubley, president and general manager of the American Transformer Co.; managers, John V. L. Hogan, general manager of the International Radio Co., and Edwin H. Colpitts, assistant chief engineer of the Western Electric Co.

ELECTRICAL ESTIMATORS OF CHICAGO ELECT OFFICERS.

The Chicago Association of Electrical Estimators elected the following officers at its meeting Monday evening, Jan. 24: President, J. R. Smith, Freeman-Sweet Co.; vice-president, A. C. McWilliams, Kohler Bros.; treasurer, W. Mullery, F. E. Newbery Electric Co., and secretary, A. Yule, Henry Newgard & Co. The association created an office known as the custodian of data and appointed E. L. Morley, Comstock Electric Co., to take charge of the work. The officers will be installed at a meeting to be held Feb. 14 at Heinly's restaurant, 41 South Dearborn street, Chicago. The program being arranged for this occasion promises to be full of interest to electrical contractors who are expected to attend.

NEW OFFICERS OF ONTARIO M. E. U. ASSOCIATION.

The Association of Municipal Electrical Utilities of Ontario elected the following officers for 1921 at its recent annual convention: President, M. J. McHenry, Walkerville; vice-president, R. H. Martindale, Sudbury; secretary, S. R. A. Clement, Toronto; treasurer, G. J. Mickler, Toronto. District vice-presidents, Niagara district, J. G. Archibald, Woodstock; central district, A. T. Hicks, Oshawa; eastern district, H. F. Shearer, Smith Falls; northern district, R. H. Stafford, North Bay; Georgian Bay district, E. J. Stapleton, Collingwood.

BOSTON AND BUFALO SECTIONS, A. S. M. E., TO MEET.

Water-power development and the standby steam stations, as applied to the general subject of power development in New England, will be discussed at a meeting of the Boston Section of the American Society of Mechanical Engineers, Feb. 8. W. M. White, chief engineer of the hydraulic department, Allis-Chalmers Manufacturing Co., Milwaukee, is scheduled to speak on the subject of "Recent Water-Wheel Developments and Settings."

The Buffalo Section of the society will hold a meeting Feb. 15, when A. M. Candy, Westinghouse Electric & Manufacturing Co., will give an address on "Modern Practice in Arc Welding."

PUEBLO UTILITY ADDING UNIT TO ELECTRICAL CAPACITY.

Extensive additions are being made to the steam power plant of the Arkansas Valley Railway, Light & Power Co., Pueblo, Colo. When completed this improvement will house a new 10,000-hp. steam turbine, boilers, surface condensing equipment and the necessary auxiliaries to insure efficient operation. The station is of sufficient size to house additional units later. Adequate coal-storage facilities will be provided and the plant will have modern machinery for handling coal and ashes. With the completion of the new unit the company will have an electric generating capactiy of 35,000 hp. Other improvements and extensions are also under way which, with the power plant additions, represent a construction expenditure of more than $1,000,000. This includes a new substation at Fowler, Colo., and increasing the capacity of the transmission lines throughout the territory served.

COMING CONVENTIONS.

National Council of Lighting Fixture Manufacturers. Annual convention and lighting fixture market, Elmwood Music Hall, Buffalo, N. Y., Feb. 14-19. Secretary, Charles H. Hofrichter, 8410 Lake avenue, Cleveland.

American Institute of Electrical Engineers. Midwinter convention, Engineering Societies building, New York City, Feb. 16-18. Secretary, F. L. Hutchinson, 33 West 39th street, New York City.

Electrical Supply Jobbers' Association. Quarterly meeting of Atlantic Division, New York City, March 15. Headquarters, Hotel Commodore. Secretary, E. Donald Tolles, 52 Broadway, New York City.

Joint meeting of Illinois State Electric Association, Illinois Electric Railways Association and Illinois Gas Association, Chicago, March 15-17. Headquarters, Sherman House. Secretary, R. V. Prather, Springfield, Ill.

American Washing Machine Manufacturers' Association. Meeting at Sherman Hotel, Chicago, March 16-17. Secretary, Enoch B. Seitz, Otis building, Chicago.

Wisconsin Electrical Association. Annual convention, Milwaukee, March 22-24, jointly with the Wisconsin Gas Association. Secretary, J. P. Pulliam, 1408 First Wisconsin National Bank building, Milwaukee.

American Electrochemical Society. Spring meeting, Atlantic City, N. J., April 21-23. Headquarters, Hotel Chalfonte. Secretary, Joseph W. Richards, Lehigh University, Bethlehem, Pa.

Electrical Supply Jobbers' Association. General meeting, Hot Springs, Va., May 25-27. General secretary, Franklin Overbagh, 411 South Clinton street, Chicago.

North Central Electric Association. Annual convention, Duluth, Minn., June 14-16. Secretary, H. E. Young, 15 South Fifth street, Minneapolis, Minn.

Tri-State Water and Light Association. Annual convention, Asheville, N. C., June 15-16. Secretary, W. F. Steiglitz, Columbia, S. C.

National Fire Protection Association. Annual convention, San Francisco, June 14-16. Secretary, Franklin H. Wentworth, 87 Milk street, Boston.

American Institute of Electrical Engineers. Annual convention jointly with the Pacific Coast convention, Salt Lake City, Utah, June 20-25. Secretary, F. L. Hutchinson, 33 West 39th street, New York City.

COMMERCIAL PRACTICE

New-Business Methods, Policies, Rates and Kindred Central-Station Matters for the Man Engaged in Selling Electricity

UTILITY EMPLOYES REWARDED FOR SERVICE RECORD.

Official of Northern Connecticut Light & Power Co. Impresses Upon Employes Duties They Owe to Utility's Customers.

In recognition of long and faithful service, employes of the Northern Connecticut Light & Power Co., Thompsonville, Conn., were given a service reward as a new year's gift at a recent meeting of the company. The rewards were on a sliding scale, based on the number of years that the employes had been in the continuous service of the company. Walter P. Schwabe, vice-president and general manager, in addressing the gathering said in part:

"I have two reasons for calling you together at this time, first, to tell you some things about the operating affairs of the company that I feel you, as employes, as well as the public, should know, and second, to impress upon you the need and importance of close attention to and the exercise of the highest degree of efficiency in your work, so that the company's financial condition will remain unimpaired, your present rate of wages maintained and the public satisfactorily served without a change in our present lighting rates.

"Some of the increases in our operating costs compared with 1916 are as follows: Purchased electricity, 50%; generated electricity, 80%; materials, 60 to 200%, and wages, 40 to 100%. We also have been notified of an increase in the charge for water power for our Windsor Locks plant that will add $1600 per year to our present power costs.

"We have made no increase in our lighting rates except that a change in our cash discount, which increased the maximum rate only 4%, was made in 1916. We have made some increases in our electric power rates, but only sufficient to cover the increases made to us by companies from whom we purchase electricity. The reason we have managed to get along without having raised our electric lighting rates is because we have been taking on many new users within the past four years on existing lines, and this additional business has been sufficient to nearly offset our increased costs. As a matter of fact, however, we have taken a loss for the past four years.

"So far we have continued to earn sufficient to pay our bond interest and regular dividends, but the amount in excess of this that we are entitled to for contingencies and surplus in order to maintain a proper financial standing has grown less from year to year. Our bonds and stocks have depreciated in price because we have not been able to increase our dividends in line with those paid by manufacturing and all other business concerns. The investor in utilities securities has taken a loss, as at the high prices prevailing his income has only a 50% value in exchange for other commodities at the present time.

"While manufacturers, merchants and others, owing to materially increased prices, have made large profits and paid the highest wages, we in the public service business have actually been taking losses and your wages have not increased as rapidly as they have in other lines of work. But the time of wage reductions, unemployment and the taking of losses by those who have profited by the high prices is now here.

"In our case we must do all we can to keep down our costs by increased efficiency and close attention to our work. That means putting in not less than a full day's work every day and doing our work right, eliminate errors and mistakes and waste of time. We must do all we can to maintain the demand for our service and every one of you should do your part toward this end by treating our patrons so they will be satisfied customers. You are all familiar with the saying that 'a satisfied customer is the best advertisement,' and you are the ones to make our customers satisfied. The company's reputation is what you, who come in contact with our customers, make it. Always remember that the existence of the company depends on the good-will of its customers.

"Remember to be polite and courteous, especially when using the telephone. When you make a promise, keep it. Do your work right and should you hear of a complaint, take the customer's view of it and report it to the proper department. With efficient management and efficient work on your part and the proper attitude in our relations with our patrons, I feel we can continue to render service at the lowest cost to the user, consistent with good service and the nature of the territory we cover, and continue to enjoy the good-will of the public."

CHART SHOWS GROWTH OF COMMONWEALTH EDISON CO.

Sales of Electricity for Lighting, Power and Street-Railway Purposes Show Gratifying Increases During Period of Twenty-four Years.

In connection with its recent capital stock sale to residents of Chicago, the Commonwealth Edison Co. issued a folder giving some facts relative to the extent of the company's operations which are identified with the progress of the community it serves. Illustrations of the Fisk and Quarry

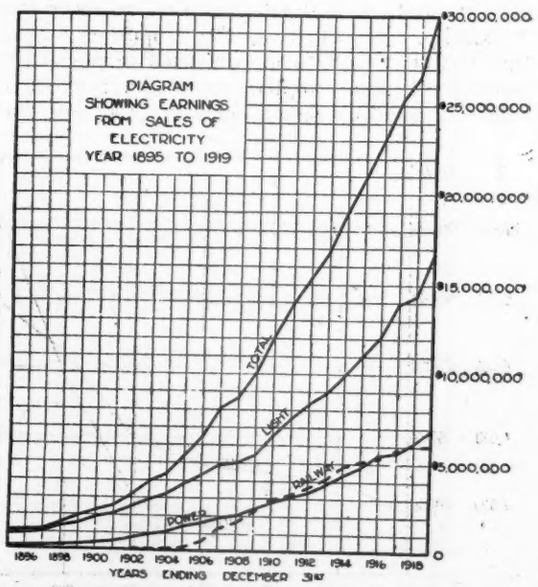


Chart Showing Earnings Growth of Commonwealth Edison Co.

street and Northwest stations are shown, together with a picture of the Edison building, in which the general offices of the company are located. A chart is also presented showing the growth in the earnings for a period of years, from which can

be observed the development due to the supply of energy to the street railways, also the earnings from sales of electricity from 1895 to 1919. The chart demonstrates that the total earnings of the company have doubled about every 4.5 years.

An analysis of the chart shows that of the total earnings for 1919 amounting to $30,000,000, sales of electricity for lighting purposes were 57%, power 23% and street railway 20%. It will be observed that sales of energy for street railway purposes did not show any particular increase from 1902 to 1904, but after that period it started an upward trend until 1918 when it reached the $5,000,000 mark and has remained at that figure since, demonstrating that few, if any, additions were made to the street railway lines in 1919. The figures for power show that in 1895 the sales were $1,000,000 and have risen steadily until in 1919 they reached approximately $7,000,000. The greatest increase is shown in the sales of electricity for lighting purposes, which in 1895 were $2,000,000, while in 1919 they amounted to about $16,700,000.

SALES OF HOUSEHOLD ELECTRICAL APPLIANCES INCREASING.

Chart Demonstrates How Retail Sales Have Grown in Territory in Which Minneapolis General Electric Co. Operates..

During the six weeks from Nov. 15 to Dec. 25, 1920, more than 23,000 household electric appliances were sold by the Standard Gas & Electric Co.'s subsidiaries and dealers in the communities in which these companies operate. Most of these appliances will be operated from the lines of the Standard subsidiaries and represent in the aggregate a considerable volume of business amounting to about 9131 kw., or more than 12,000 hp. Reports from the properties indicate that the electric flatiron continues in popularity, leading all other appliances in the number of sales, followed by vacuum cleaners, toasters, curling irons and washing machines in the order named. A surprising feature of the combined report is the apparent large demand for electric vibrators.

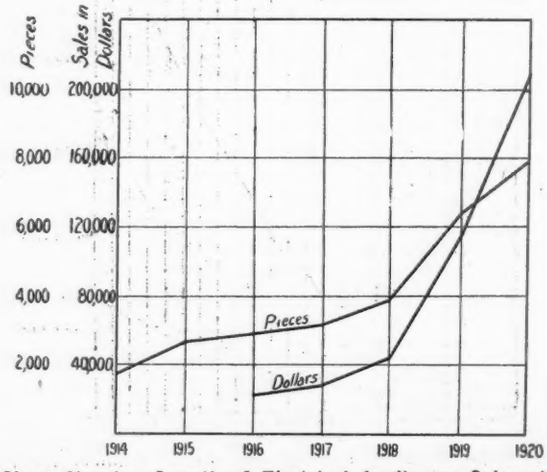


Chart Showing Growth of Electrical Appliances Sales at Minneapolis.

The Minneapolis General Electric Co. lead the list with 10,128 appliances sold, the Louisville Gas & Electric Co. was second with 5250 and the San Diego Consolidated Gas & Electric Co. third with 1600. The increasing use of electrical appliances in the home is demonstrated in the chart which shows how the sales have grown in the Minneapolis territory during the period from 1914 to 1920. An analysis of the figures gives approximately $7.60 as the average cost of electrical appliances sold in 1916 as against $26.60 in 1920. Electrical appliance sales, as shown by the chart, amounted to 2900 pieces in 1916 and increased to 7900 in 1920, the sales in dollars being $22,000 and $210,000 respectively.

UTILITY PROPERTIES OUTLINED IN SPECIAL LEAFLETS.

From time to time the physical properties of the Rochester (N. Y.) Gas & Electric Corp., especially its largest and newest installations, are visited by individuals and delegations, usually engineers and scientists of note, who desire to keep in touch with the progress made in central-station equipment. On some of these occasions the Rochester utility has issued to the visitors special descriptive leaflets containing plans and other data on the various plants operated by it, with the idea that as potential stockholders they will be interested in these concise descriptions of the properties in which their money may be invested. The leaflets in question cover the hydro-electric development at Lower Falls, Genesee river; new coal gas plant at the foot of Falls street, Rochester; hydroelectric station No. 2, and the steam electric station No. 3.

CENTRAL-STATION COMPANY SHOWS GAIN IN NEW METERS.

During the month of November the Binghamton (N. Y.) Light & Power Co. had the highest 60-min. demand, largest kilowatt-hour output and the largest operating revenue for any single month in its history. It is expected that Binghamton will be one of the last cities to feel any industrial depression and one of the first to recover, due not only to the fact that it had very little war business but also to its diversified industries. During November, 1920, ten new customers were connected, varying in size from 1 to 40 hp., while the Achilles Tire Co. and the Binghamton Glass Works each added 75 hp. to their installations. The net gain in new meters during this period was 176.

OHIO ELECTRIC COMPANY PUTS NEW UNIT IN SERVICE.

The Sandusky (O.) Gas & Electric Co. has recently completed the preliminary and test runs on the new 5000-kw. generating unit in its power house and it is expected that it will now remain on the line, relieving the overloaded condition of the former generators and thereby effecting economies. In the period from July 1 to Dec. 18, 1920, 518 residential and 36 commercial customers were connected to the company's lines.

OPERATING PRACTICE

Methods and Problems Embracing Operation and Installation of Power-Plant Equipment and the Distribution of Electrical Energy

POOR FEEDER REGULATION CAUSED BY NEUTRAL CURRENT.

In a distribution system where the energy was sent out from the substation at 2300/4000 volts, Y-connected with the neutral wire grounded at the substation, there were two circuits which followed parallel routes on the same pole line for approximately 2 mi. Throughout this distance a common No. 4 neutral wire was used for both

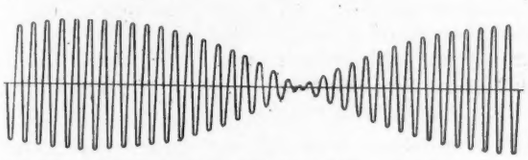


Diagram of Current in Neutral Wire Common to Circuits of Different Frequency.

circuits. The phase wires of each of the circuits were equipped with automatic feeder regulators and voltmeter line-drop compensators so that each phase could be regulated independently. Trouble was experienced with the regulation and was manifest by unaccountable voltage fluctuations which were so erratic that the automatic regulators did not take care of them. The trouble was finally traced to the use of the common neutral for the two circuits. Neither of the circuits carried a balanced load. Hence, each circuit contributed a current to the neutral wire and the resulting current in the wire was the vector sum of the currents of the two circuits. This current produced a voltage drop due to the resistance of the wire. As long as this drop is fairly constant it can be readily compensated for, but unfortunately in this instance it was not constant. The fluctuation in the voltage of the circuit proved to be periodic, and this fact suggested the cause of the difficulty.

The system was supplied from two entirely separate buses, both operating nominally at 60 cycles. One of the circuits was supplied from one of the buses and the other from the second bus. The two buses, as the results showed, were not operating at exactly the same frequency. Due to this fact the sum of the two neutral currents produced an alternating current with a variable amplitude which ranged in value from the sum of the amplitude of the two currents as a maximum to the difference of the two as a minimum. The period between the occurrences of the maximum and minimum values of the neutral current depended upon the difference in the frequency of the two buses. This variation in the value of the neutral current produced a corresponding fluctuation in the voltage drop along the neutral wire. The less the difference in the frequency of the two buses the longer the period was between the maximum and the minimum values of the neutral voltage drop. With frequencies of 60 and 60½ cycles the periods of maximum drop followed each other at intervals of 2 sec. With 60 and 60¼ cycles the periods of maximum drop followed each other at intervals of 4 sec., producing a corresponding dimming of the lights at the same intervals. The trouble was temporarily remedied by rearranging the operating schedule so that the two circuits in question should always be supplied from the same bus until such a time as independent neutral wires could be installed.

DETERMINATION OF EXPANSION IN STEAM PIPES.

By W. F. Schaphorst.

The accompanying chart should be found convenient to determine in a most quick and simple manner the number of inches expansion in any metal from mild steel to bronze. It handles any length of steam pipe or bridge, etc., from 20 ft. to 10,000 ft. For example, if it is desired to determine how much 850 ft. of wrought-iron steam pipe will expand where the temperature variation is 300 deg. F., the procedure is as follows: Connect the 300 (column *C*) with the coefficient of expansion of wrought iron (column *E*) and locate the intersection with column *D*. Then, from that point of intersection run over to 850 (column *A*) and the expansion is found to be 20 ins. (column *B*).

So, all that is required in the solution of a given problem is to lay a straightedge across the chart in two places and the total expansion in inches

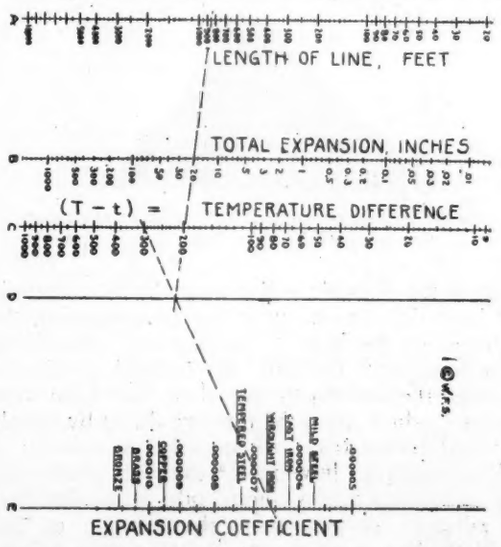


Chart for Determination of Expansion With Changes in Temperature.

is determined without bothering with figures or the decimal point. If a straightedge is not at hand a thread, a straight piece of paper, or anything else that is convenient and that happens to

be straight may be used. It will be noted that this chart can be used for any material having a coefficient of expansion between 0.000,005 and 0.000,012. The coefficients of the principal metals that fall between those limits are indicated on the chart for convenience.

Temperature variation (T-t) is found by subtracting the minimum temperature from the maximum. Thus a steam pipe at its coldest may have a temperature of 40 deg. F. At its hottest it may have a temperature of 440 deg. F. The difference is therefore 440 — 40 = 400 deg. F.

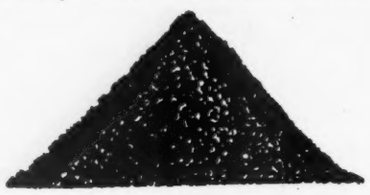
HIGH RATES OF COMBUSTION WITH MECHANICAL STOKERS.

Combustion rates up to 60 or 70 lbs. of coal per sq. ft. of grate per hr. are now attained with good efficiency in stoker-fired plants, and single stokers with areas of 150 to 200 sq. ft. are in operation. It is this high combustion rate and large grate area, together with modern ash-handling equipment, that has made possible the economical operation at high ratings of the large boilers now becoming common. Ash disposal is one of the important problems to be met in the operation of large units. It has been estimated that the ash content of coal burned under boilers in 1920 was from 10 to 20% greater than in previous years, this increased ash causing much difficulty and, in some cases, limiting the boiler output.

QUANTITY OF COAL IN A NATURAL CONICAL PILE.

By W. F. Schaphorst.

Because of the fact that when bituminous coal is piled loosely on the ground or on a floor it assumes a fairly definite angle of repose, it is fairly easy to develop a formula for computing the number of tons in a natural conical pile. The weight of bituminous coal per cubic foot is a fairly constant quantity also, which makes the development of the formula still easier. Such a formula has been developed, but it involves squaring the diameter of the base of the pile and multiplying by a constant. To make the method as easy as possible the accompanying chart has been constructed, which gives the tonnage direct by simply glancing across from column *A* to column *B*.



Typical Section Through a Natural Conical Pile of Bituminous Coal.

For example, how many tons of bituminous coal is contained in a conical pile whose diameter is 30 ft.? To determine the solution of this problem it is necessary to find the 30 in column *A* and glance across to column *B* to find the answer—about 68 tons. Inversely, the chart can be used to determine the size of plot needed for storing a given amount of bituminous coal. For example, what size of plot will be needed for the storing of 200 tons of bituminous coal in a conical pile? In this case it is necessary to find the 200 in column *B* and glance back to column *A*. The answer is about 44 ft. The range of the chart, it will be noted, is great enough to take care of most ordinary piles. It varies from 2 to 100 ft. in diameter. In a 100-ft. pile there would be about 2500 tons of coal.

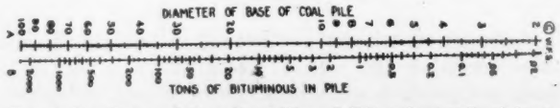


Chart for Determining Quantity of Bituminous Coal in a Conical Pile.

WEIGHT OF ASH AND VARIOUS KINDS OF COAL.

In taking inventory of fuel stocks, or in estimating sizes of bins for a given quantity of fuel, it is often necessary to know the weight of a given volume of a certain kind of coal. The accompanying table, which appeared in the *American Contractor,* supplies the needed information in a convenient and concise form.

TABLE SHOWING WEIGHTS OF COAL AND ASH.

Material.	Weight in lbs. per cu. yd.	Volume of 5 tons in cu. yds.
Ash, clinkers and cinders	1,700	2.35
Coal, anthracite, lump	1,875	2.13
Coal, anthracite, broken	1,782	2.24
Coal, anthracite, egg	1,753	2.28
Coal, anthracite, stove	1,736	2.3
Coal, anthracite, chestnut	1,693	2.4
Coal, anthracite, pea	1,646	2.43
Coal, bituminous	1,500	2.66
Coal, Cumberland	1,450	2.76
Coal, cannel	1,360	2.94

AN ELECTRICALLY CHARGED WATER PIPE IN CONCRETE BUILDING.

Some time ago the attention of the writer was called to a case of wiring trouble which produced an effect that was quite misleading. The trouble was reported by a printer who complained that his water pipes were charged with electricity and that every time he touched the water faucet in his plant he received a shock. When the inspector of the central station company started to investigate the trouble he found the printer's statement as to the shock to be correct. It did not seem reasonable, however, that the faucet, connected to an underground water system by a metal pipe, should be at a potential sufficiently high to give a person an electric shock. It was reasoned that it was more likely that the floor on which the person was standing when the shock was experienced was at a potential above the ground, and that the source of the stray current was in the floor.

The printing shop was in the second story of the building which was constructed with a floor of reinforced concrete with the wiring for the first floor installed in iron conduit laid in the floor. A live wire of the 110-volt grounded lighting circuit had come in contact with the iron conduit which in turn carried the current to the damp concrete floor under the faucet and raised the floor to a potential of 110 volts above the ground potential of the pipe. When the insulation of the lighting circuit was restored the apparent charge on the faucet disappeared.

Let "white coal" do the work.

NEW APPLIANCES

Newly Developed and Improved Electrical and Mechanical Apparatus, Appliances, and Devices Now Being Placed on the Market

Potentiometer Indicator for Wall Mounting.

The wall-type potentiometer indicator being marketed by the Leeds & Northrup Co., Philadelphia, is contained in a cast-metal box with black lacquered sides and nickel-plated cover. The box is made as nearly dust-proof as possible, but can be readily opened for cleaning should that become necessary. The parts that are exposed when the box is opened for cleaning are not easily damaged, and the instrument is free from parts of delicate construction. Like other indicating, recording and controlling potentiometers made by this company, the calibration of the instrument depends on the constancy of two of its elements—a standard cell and a manganin resistance wire. Both the standard cell and maganin wire are

Wall-Type Potentiometer Indicator.

accepted standards for work demanding greater accuracy than that required of the potentiometer indicator. The galvanometer in this instrument is an interchangeable part. It is not calibrated, but serves merely to indicate when no current flows in the potentiometer circuit, and the calibration of the instrument is in no way connected with the constancy of the galvanometer.

The scale is the same size as that on other indicators, being 137 mm. long. It has clear open divisions so that even with the long range of 200 to 1800 deg. F. the smallest division, 20 deg. F., is more than ⅛ in. in width. With the minimum range, 0 to 300 deg. F., the smallest division, 2 deg. F., is 3/32 in. in width. The accuracy of the instrument is guaranteed to be 0.5% of the range, and holds over all portions of the scale. With the longer range a change in temperature of 4 deg. F. is readily detected, and with the shorter range a change of 1 deg. F. is noticeable.

To obtain a temperature reading with this instrument it is only necessary to turn the knurled knob until the galvanometer pointer comes to zero and then read the temperature under the index on the main scale. It is necessary once a day to adjust the current in the potentiometer circuit by balancing against the self-contained standard cell. To do this it is necessary to remove the knurled knob from the main scale, place it in the receptacle below and to the right, press the key, and turn the knob until the galvanometer pointer rests on zero.

Motor-Driven Ironing Machine.

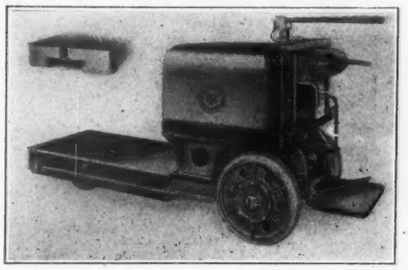
The Oasis Manufacturing Co., Peoria, Ill., has placed on the market a motor-driven ironing machine, the operation of which is controlled by a pedal so that both hands of the operator are free to manage the work. The iron is mounted so that the shoe may center itself with relation to the roll regardless of the thickness of material passing through the machine. The maker states that the result of this construction is that the pressure upon the material is always uniform throughout the area of the ironing shoe, the trunnions which carry the shoe having their bearing in the upper ends of the arms which extend up from the frame. The rocking motion allows for any inequalities in the material being ironed, so that buttons, raised embroidery and other articles of increased thickness pass through without receiving any greater pressure at the thick point than is applied to the rest of the material.

The receiving table of the machine is mounted on an angle so that the finished work travels forward by gravity to a point where the operator can remove it from the machine without reaching under the ironer. The ironing element has a thick face for retaining and giving an even distribution of heat. The roll is kept true and round by means of metal ends and turned expansion rings between the ends, together with truss rods which pass through the roll. The ironing shoe is ordinarily heated by gas, but it is constructed so that electric heaters or steam can be used.

Self-Loading Electric Truck.

A self-loading industrial truck of improved design has recently been placed on the market by the Industrial Truck Co., a division of Cowan Truck Co., Holyoke, Mass. The truck is of steel construction and guaranteed for 5000 lbs. capacity, which is said to be 1000 lbs. greater than the usual guaranteed load for this type of truck. It has a quick-acting elevating mechanism, and elevates in 5 seconds when equipped with a storage battery of 28 cells and in 6 seconds with 21 cells. The lifting mechanism is operated by an independent heavy-duty series-wound motor and worm gear reduction. The platform lifts vertically, the rise being 4.5 ins. The platform may be stopped at any point going up or down, and it requires only 3 seconds for full lowering. The rear end is equipped with a heavy bumper which takes all shocks and protects the rear end of the lift platform. The rear end is also equipped with a draw-bar attachment which enables the truck to be used as a tractor.

Automatic brake and circuit-breaker application, four-wheel steer, single-



Industrial Battery Truck of All-Steel Construction.

reduction worm drive of the power axle and easy accessibility of batteries, lifting, driving and control mechanism are features of the truck. It will operate in intersecting aisles 60 ins. wide, the turning radius at the extreme outside point being 7 ft. 10 ins. By folding the foot pedal and steering handle into a vertical position the overall length is shortened for use on elevators. The length is 102 ins. overall, or 91.5 ins. with the step raised. The width is 36 ins. overall, and it is 51 ins. high over the steering-shaft head. Either alkaline or lead batteries may be used as desired. The controller is of the drum type with three speeds forward and three reverse. This type of truck has been subjected to rigid tests under various operating conditions, and its all-steel construction, low center of gravity, general compactness and ruggedness have demonstrated its service qualities.

An Indicator for Water Level in Storage Batteries.

An aid to comfort and confidence in automobile operation is found in the "Batometer" being manufactured by the Hempy-Cooper Manufacturing Co., of Kansas City, Mo., and distributed by the Fairbanks Co., New York City. The Batometer is a device mounted on the dash of the car which indicates to the driver the level of the electrolyte in the storage battery, and can be used on any make of battery or car. The "Water" scale in the Batometer is connected by flexible wires to lead electrodes which are built in the regular filler caps. These electrodes project

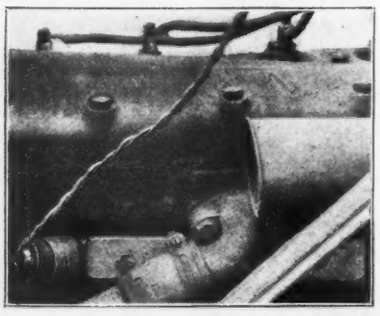
down into the cells almost to the tops of the plates. While the electrolyte is sufficiently high the needle points to "High." When it falls below the ends of the electrodes the circuit is broken and the needle swings over to "Low." The Batometer indication is not delayed until after damage is done, for when the needle points to "Low" there is still 24 hrs. to drive to a battery service station for an examination before trouble will start. The Batometer will be sold through automobile accessory dealers and battery service stations. As an ammeter is mounted in the same case, the Batometer will replace the ammeter or charge-and-discharge indicator. The Batometer is furnished in flush or flanged types with the same outside dimensions as the regular ammeter or indicator.

Ammeter With Water-Level Indicator in Single Case.

"Calorel" Automobile-Engine Heating Unit.

The automobile-engine heater being manufactured by the National Electrical Supply Co., Washington, D. C., consists of a seamless steel tube 13 ins. long swaged out at one end to receive a standard motor-connector terminal, and flattened down 11 ins. of its length, incasing the heating element and protecting it from exposure and possible damage. The element is capable of withstanding 200% heat overload indefinitely, according to the statement of the manufacturer.

This one-piece, seamless, steel-clad structure produces an element which may be immersed in liquid, oils or grease, or placed against the carburetor or around gasoline and inflammable materials with no danger. Its prime use is in placing it adjacent to the water-circulating system of the engine, keeping the water warm and circulating, preventing freezing, and facilitating starting. The device may be installed permanently or inserted as required.

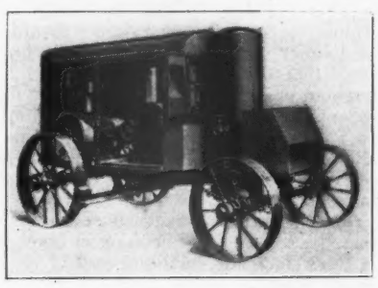


Heater to Warm Circulating Water in Automobile Engines.

It is interesting to note that the heater is not placed in or adjacent to the radiator, but adjacent to the water system of the engine, thereby producing a normal circulation of water upward through the engine. This arrangement being of such efficiency that the heater consumes only 140 watts and produces sufficient heat for a four-cylinder engine under normal conditions in a protected garage. In case of larger engines, or in unprotected locations, two or more heaters may be used.

Imperial Portable Compressors.

Contractors using compressed air are familiar with the gasoline-engine-driven "Imperial" portable compressors manufactured by the Ingersol-Rand Co., New York City. These units are driven by tractor-type gasoline motors, and are built in three sizes with capacities of 45, 118 and 210 cu. ft. per min. To meet the increasing needs of the contractors, street railways and public service companies having available electric current, a motor-driven "Imperial" compressor has been added to the line of equipment manufactured by this company. This unit is of 118 cu. ft, capacity and weighs approximately 4450 lbs., depending upon the weight of the motor. Similar to the corresponding gasoline-engine-driven compressor, this electric unit is an all-steel outfit from its sheet-metal canopy to the broad-tired steel wheels. Light steel doors completely house the entire unit protecting it from the weather. These doors are easily removed to allow access to all parts.



Portable Motor-Driven Air Compressor.

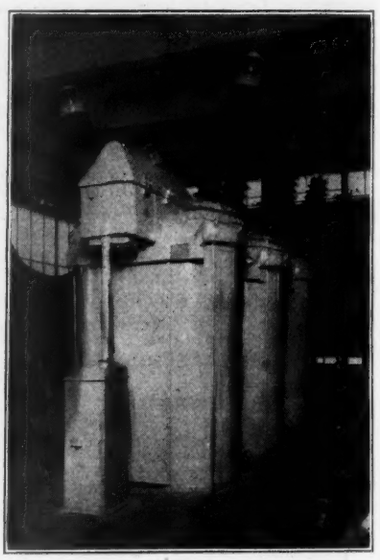
A suitable intake unloader is provided, assuring efficient regulation. Either an alternating or direct-current motor can be used as required. In any case the motor control is in accordance with standard practice and specifications covering the type of motor used. Additional equipment with the outfit includes an air receiver, safety valve, drain valves, pressure gauge and service valves to which air lines may be connected.

Motor-Driven Portable Jig Saw.

A motor-driven portable jig saw has been placed on the market by the Clapp-Eastham Co., Cambridge, Mass. Fiber, gutta percha, asbestos board, leather, wood and soft substances such as felt are readily cut by this machine. The saw is driven by a 1/6-hp. motor which is belt-connected to the machine. A small blower is provided which automatically adjusts itself to the proper position.

Circuit-Breaker for 165,000-Volt Service.

What is said to be the largest oil circuit-breaker in the world, shown in the accompanying illustration, has just been completed by the General Electric Co., Schenectady, N. Y., for the Great Western Power Co. of San Francisco. It is one of seven of the same size which are being built for installation on the property of that company.



Largest Oil Circuit-Breaker Ever Built.

The breaker is built for operation at 165,000 volts and 400 amperes at an altitude above sea level of 4000 ft. It is solenoid operated, the solenoid being actuated through a relay which is energized by a bushing transformer. It is closed by means of a pull-button switch located wherever convenient. The contacts, explosion chambers, etc., conform to the standard design of this type of equipment. A few of the dimensions give an idea of the construction required for operation at such high voltage. The total length of the three units is 32 ft., and the height measured from the bottom of the tank to the top of the insulators is 16 ft. The complete apparatus weighs approximately 25 tons and requires over 4000 gals. of oil to fill the tanks.

Remote-Control Panel for Radio Operation.

To save time and labor in the operation of radio sets of substantial size, the Wireless Specialty Apparatus Co., Boston, is placing on the market a remote-control panel designed to govern circuit adjustments at a distance from the main apparatus. This equipment is now being marketed for 2-kw. sets and is being built for 5-kw. sets. It may be built soon for units having a total power rating up to 30-kw.

ACTIVITIES IN THE TRADE

Business Developments, Sales Agencies, Trade Literature and Miscellaneous Items Concerning Electrical Manufacturers and Allied Business Interests

C. D. Electric Co., Philadelphia, is arranging a consolidation of its interests with the Erie Lighting Co. B. Marx is secretary.

Pittsburgh Gas & Electric Fixture Co., Pittsburgh, has purchased the Lightolier Fixture Co., 19 North Ninth street, including stock.

J. J. Ross Engineering Co., Detroit, manufacturer of battery-charging equipment, etc., is enlarging its quarters for increased production.

Troy Electrical Co., Troy, N. Y., manufacturer of electrical specialties, has filed notice of increase in its capital stock from $10,000 to $30,000.

Hertner Electric & Manufacturing Co., 1905 West 114th street, Cleveland, plans to erect a one-story factory building at an estimated cost of $60,000.

Electrical Engineering & Manufacturing Co., Pittsburgh, has leased space in the 6-story building at 928-30 Penn avenue for a new local works.

Porter Electric Co., Utica, N. Y., manufacturer of electrical equipment, has filed notice of increase in its capital stock from $20,000 to $100,000 for expansion.

Alloy Metal Wire Co., 154 Nassau street, New York City, manufacturer of electrical wires, etc., has filed notice of increase in its capital stock from $100,000 to $200,000.

Maille Electric Co., Inc., Providence, R. I., has removed from 24 Garnet street to new quarters at Fountain and Dean streets, where increased facilities are provided.

Max Rockmore, receiver for the Premier Incandescent Lamp Works, Inc., New York City, has arranged for the sale of the company's property, including plant equipment.

American Insulator Co., New Freedom, Pa., manufacturer of electrical insulation equipment, has plans under way for the erection of a two-story plant on Main Street, Norwalk, Conn.

Electric Service Supplies Co., Cambria and 17th streets, Philadelphia, manufacturer of electrical specialties, has acquired property on 17th street, near Glenwood avenue, to be used for future factory extensions.

Corning Glass Works, Inc., Corning, N. Y., manufacturer of electrical glassware, bulbs, etc., has arranged for a stock issue of $3,000,000, the proceeds to be used for general financing and for proposed plant extensions.

Acorn Insulated Wire Co., 75 Richards street, Brooklyn, N. Y., has acquired the plant of the Davis Oil Co., on Ninth street, extending to the Gowanus basin bulkhead, for a new plant for the manufacture of insulated electrical wires and other products.

Waage Electric Co., 12 South Jefferson street, Chicago, has announced that Edward Florence has been appointed sales manager for the company. Mr. Florence was formerly office manager for the Westinghouse Lamp Co.

Adamson Manufacturing Co., East Palestine, O., has announced that it has added a department for manufacturing storage, pneumatic and pressure tanks, welded pipe, battery casings, evaporators, condensors and a line of arc-welded products.

Robbins & Myers, Co., Springfield, O., manufacturer of electric motors, generators and fans, has recently moved its executive offices from Plant

New Office Building of Robbins & Myers Co., Springfield, O.

One to more commodious quarters in the new office building recently acquired by the company. As a result of the additional space afforded by the completion of the office building, the "R. & M." club rooms have been moved from their present quarters in the Bushnell building to the factory.

General Bakelite Co., New York City, has issued a pamphlet on "Bakelite" coil impregnation, which gives some facts relative to the properties and applications of this product. It is stated that "Bakelite" has the unique characteristic of hardening under the application of heat into an infusible, insoluble mass, which makes it suitable for impregnating electrical coils and windings, for coils so impregnated remain intact under overload temperatures.

Instantaneous Electric Heater Corp., Root building, Chippewa street, Buffalo, N. Y., recently organized to manufacture electric heating devices, has plans under way for the erection of a local plant. Negotiations are being conducted for the purchase of a three-acre site for the works, which will be equipped for a capacity of over 500 electric heaters per day. The company is capitalized at $500,000, and a stock issue totaling $200,000 has been arranged for the new plant construction.

F. E. Newbery Electric Co., Lytton building, Chicago, has announced that Harry C. Newkirk, formerly western manager for L. K. Comstock & Co., has become a member of the firm and will continue the business of electrical and mechanical engineering and contracting as vice-president and manager.

Majestic Electric Development Co., 656 Howard street, San Francisco, manufacturer of electrical appliances, at the annual meeting of stockholders held Jan. 15 re-elected the following officers: President, E. N. Brown; vice-president, M. H. Shoenberg, and secretary, T. D. MacMullen. These officers, together with B. C. Brown, constitute the board of directors.

Clifton Manufacturing Co., Boston, manufacturer of enamel and galvanized steel conduits, insulating tapes and compounds and specialized rubber goods, has moved its offices into the new addition recently made to its plant at 63 Brookside avenue. The portion of the old building made vacant by this change will be used for factory purposes, thus affording the company additional production facilities.

Davis Slate & Manufacturing Co., 610 East 40th street, Chicago, electrical slate and marble producer, plans to open up a quarry in Vermont for the production of purple electrical slate. The company will also build and equip a slate mill in connection with the quarry project, which it expects to have in operation about March 1. The additions contemplated to the Davis facilities will represent an increased investment of about $400,000 for quarry land, factory site, buildings and machinery.

Cutler-Hammer Manufacturing Co., Milwaukee, has issued a booklet entitled "Development of Electricity in the Merchant Marine," and known as publication 890, which tells the story of the evolution of the engine-propelled ship from the historic "Clermont" to the efficient present-day craft propelled by the steam turbine or the Diesel engine. During the last several years there has come hand-in-hand with this development a greater realization of the advantages of electric-driven auxiliaries and, states the booklet, the Cutler-Hammer company has played no small part in popularizing electric control on board ship by solving many of the problems encountered in the application of electric control to marine auxiliaries. The requirements peculiar to electric control on ships are briefly discussed and a description of electric control of auxiliaries on the motorship "Solitaire" will be of interest to men in the marine field. The booklet is illustrated with views taken aboard the "Solitaire," and several controllers are shown as typical of these required for marine work.

PERSONAL MENTION

Biographical Sketches and Chronicle of Changes in Business Connections, Promotions and Other Personal News of the Industry

CHARLES DAY, senior partner of Day & Zimmerman, Philadelphia, Pa., industrial engineers, has been elected a director of the Philadelphia Trust Co.

ARTHUR H. ABBOTT has been appointed New England representative of the Ohio Electric & Controller Co., Cleveland, with offices at 88 Broad street, Boston.

EUGENE F. FAGAN, formerly general superintendent of the Federal Electric Co., Chicago, has been appointed purchasing agent of the Lyon Metallic Manufacturing Co., Aurora, Ill.

E. W. KENDALL has been appointed general sales manager of Pass & Seymour, Inc.; manufacturer of electric wiring devices, Solvay, N. Y., to succeed F. S. Baldwin, who recently resigned.

CHESTER ROWELL resigned Jan. 24 as a member of the United States Shipping Board to assume his duties as a member of the California State Railroad Commission, to which he was recently appointed by Governor Stephens to succeed E. O. Edgerton.

W. H. MORTON, general secretary and treasurer of the National Association of Electrical Contractor-Dealers, spoke before a meeting of the Ontario Association of Electrical Contractor-Dealers at Toronto, Can., Feb. 3, on the "Work of the National Association."

J. ALLEN SMITH has resigned as president of the United Light & Heat Co., Niagara Falls, N.Y. He has also severed his connection with other John N. Willys interests, resigning as president of the New Process Gear Corp., Syracuse, N. Y., and as vice-president of the Willys Corp.

CALVIN H. NEALLEY, vice-president and general manager of the Eastwood Wire Manufacturing Co., Belleville, N. J., has come into a controlling interest in the corporation through the terms of the will of John Henry Eastwood, recently deceased. There will be no change in management or operations, and George T. Casebolt will continue as president.

JOHN T. KELLY, chief newspaper writer on the staff of the Society for Electrical Development, New York City, has resigned to take up the direction of the national publicity and advertising campaign of the National Prosperity Bureau, which was recently formed by representatives of 24 national business associations to stimulate a return to normal buying.

GUY HANNA, Sullivan, Ind., local superintendent for the Wabash Electric Co., for about 5 years past, has been transferred to a similar position for the company at Clinton, Ind. He will be succeeded at Sullivan by John T. Kester, heretofore manager for the Noblesville Heat, Light & Power Co. For the Wabash company he will also be in charge of the plants at Farmersburg and Shelburn.

PAUL F. WILLIAMS, formerly assistant to engineer of distribution of the Commonwealth Edison Co., Chicago, has been appointed engineer of distribution.

W. G. KELLEY, engineer of overhead line extension of the Commonwealth Edison Co., Chicago, has been appointed assistant to engineer of distribution.

CHARLES W. MCKAY, formerly connected with the engineering firm of McMeen & Miller, Chicago, and subsequently chief appraisal engineer for L. V. Estes, Inc., has recently been appointed president and general manager of McKay & Sherman, valuation engineers, with general offices at 741 Monadnock block, Chicago. The firm also has offices in New York, Indianapolis, Washington, D. C., and other cities. Mr. McKay is the author of the series of articles which ran in the ELECTRICAL REVIEW during 1919 on the general subject of "Electric Utility Rates and Valuations." Mr. McKay's new connection will be of especial interest to the readers of the ELECTRICAL REVIEW in that it places him in closer touch with the electric utility field. He has been engaged in engineering and appraisal work since his graduation from Siblev College of Mechanical Engineering, Cornell University, in 1906. In July, 1906, he entered the employ of the New York & New Jersey Telephone Co. (now the New York Telephone Co.), and after serving a brief apprenticeship in the maintenance department was assigned to the plant-engineering department. He was appointed engineer for the North Brooklyn district in 1909, having charge of the preparation of plans and estimates for all outside construction work within the district. In 1910, at the time the New York Telephone Co. absorbed all of the up-state Bell companies, Mr. McKay was assigned to special work and spent the greater part of the following year in inspecting a number of the larger of the company's newly-acquired properties, and in 1911 was appointed engineer of the Borough of Queens. During the year 1912-13, Mr. McKay was associated with Henry Floy in the capacity of assistant engineer, and while holding this position he was identified with several important appraisal cases. In the summer of 1913 he became engineer to the McCall & Clark Co., efficiency experts of New York City, and in October, 1913, became affiliated with McMeen & Miller, Chicago, and while with this firm he spent the major portion of his time on problems involving the appraisement of public utility properties. He later engaged in valuation work for the Central Union Telephone Co. and continued in this capacity until his appointment with the Cooley & Marvin Co. He is a prolific writer on appraisal subjects and has contributed extensively to the technical press. The firm of McKay & Sherman is specializing in problems involving the evolution of electric utility and industrial properties. P. C. Sherman, vice-president, is one of the foremost industrial engineers in the country, and is president of Sherman and Associates, Inc., of New York City.

C. W. McKay.

PATRICK PHELAN, who had been connected with the Commonwealth Edison Co., Chicago, for over 25 years, retired from active service recently. He entered the employ of one of the predecessor companies at the old Market street station and when the Fisk street station was placed in operation in 1903 he was transferred there, being appointed watch boiler room engineer in 1912, which position he held up to the time of his retirement.

JACOB HEKMA, secretary and treasurer of the Commonwealth Power, Railway & Light Co., Jackson, Mich., has been appointed vice-president of the company, and G. H. Bourne, assistant secretary and assistant treasurer, succeeds him as secretary, and George Sprague, Jr., becomes treasurer. H. G. Kessler was made comptroller, E. E. Nelson, assistant secretary, and O. R. Coleman, assistant treasurer.

OBITUARY.

WILLIAM C. LOTT, Rockville Centre, L. I., N. Y., electrical engineer, died at his home Jan. 22, aged 74 years. He assisted in making the lighting installation for the Statue of Liberty.

CURTIS CLAYPOOLE died at Glen Wilton, Va., Jan. 19, in his fifty-fifth year. He was formerly vice-president and treasurer of the Wirt Electric Co., Philadelphia, and at the time of his death he was manager of the accounting department of the Princess Iron Corp.

BUSINESS OPPORTUNITIES

News of Electrical Construction Projects in All Parts of the Country, Proposals Invited, Foreign Trade Openings and New Companies

EASTERN STATES.

Boston, Mass.—The Bureau of Yards & Docks, Washington, D. C., has awarded a contract for the erection of a new radio building here to W. F. Martens, Rochester, N. Y.

Boston, Mass.—The John West Thread Co., 1342 Columbia road, has filed plans for alterations and improvements in its power house.

Charlestown, Mass.—The Charlestown Gas & Electric Co., 29 Main street, has construction under way on a new one-story, brick and reinforced concrete sub-station, 36 by 52 ft.

Taunton, Mass.—The Municipal Lighting Department has awarded a contract to the Simpson Brothers' Co., 77 Summer street, Boston, for extensions and improvements in the local power plant to cost about $300,000, including equipment. The work will include boiler and pumping apparatus, electrical equipment, etc.

Worcester, Mass.—Electrical and mechanical equipment will be installed in the plant addition to be erected by the American Steel & Wire Co., Grove street, at its South Works, to be three-story, brick and concrete, 120 by 145 ft., and estimated to cost about $150,000.

Bridgeport, Conn.—The Bridgeport Hydraulic Co., operating local utilities, has filed notice of increase in capital to $10,000,000.

Hartford, Conn.—The Hartford Electric Light Co., has filed notice of increase in capital from $15,000,000 to $20,000,000.

Providence, R. I.—The Narragansett Electric Lighting Co., has filed plans for the erection of a new three-story power house on Elm street.

Brooklyn, N. Y.—A power house, 35 by 45 ft., will be erected by the General Laundry, Inc., at its plant, 835-37 Myrtle avenue. The work is estimated to cost about $75,000. Shampan & Shampan, 50 Court street, are architects and engineers.

Brooklyn, N. Y.—The Nassau & Suffolk Lighting Co., has arranged for a bond issue of $436,000 for proposed extensions and betterment work, and general operations. Headquarters of the company are at 149 Broadway, New York City.

Buffalo, N. Y.—The Buffalo General Electric Co. is planning for a number of extensions in its distributing lines to serve new consumers in outlaying districts of the city. It is estimated that from 100 to 145 mi. of wire will be required to make the proposed extensions, and it is expected to have the work completed by the middle of the year.

Buffalo, N. Y.—The city council has voted down the proposition as negotiated by Commissioner Graves to enter into agreement with the Niagara Power & Development Co., for the construction of a new hydro-electric power plant at Niagara Falls, with transmission system extending to Buffalo, recently announced. The company has announced its intention of proceeding with the project, estimated to cost about $10,000,000, regardless of the attitude of the municipal government. A special power committee of the local chamber of Commerce has issued a statement disapproving of the city building a municipal power plant, or of the creation of another electric distributing company with duplication of service in various parts of the municipality.

Brooklyn, N. Y.—Fire at the plant of the Kings County Lighting Co., South Brooklyn, Jan. 23, caused a loss estimated at about $5000.

Lancaster, N. Y.—The Depew & Lancaster Light, Power & Conduit Co., of which Ernest Feyler is president, plans to erect an electric power plant at Colden, Erie county.

Long Beach, N. Y.—The Public Service Commission has granted permission to the borough council for the construction and operation of a municipal electric light and power plant for local service, as well as for light and power supply at West Beach.

New York, N. Y.—Electrical and mechanical equipment will be installed in the proposed addition to the ice manufacturing plant of the Knickerbocker Ice Co., 481-99 West 184th street. Application for permission to build the extension has been made to the zoning commission.

New York, N. Y.—The Consolidated Ship Building Co., Morris Heights, has broken ground for the construction of a one-story power house at its plant on 177th street.

New York, N. Y.—The New York Edison Co., Irving place and Fifteenth street, has taken out a building permit for the erection of a one-story transformer station at 120-22 Cedar street. The company has acquired property at 33 Attorney street, to be used in connection with operations in this section.

Glassboro, N. J.—The borough council has plans under way for extensive additions in the present street-lighting system. New 250-cp. lamps and smaller lighting units will be installed. E. M. Duffield is mayor.

Irvington (Newark), N. J.—The town commission has arranged an appropriation of from $17,000 to $18,000 for street-lighting during the coming year.

Maurer, N. J.—The power plant to be erected by the Barber Asphalt Paving Co., Land Title building, Philadelphia, at its local works will be two-story, 75 by 118 ft. Lockwood, Greene & Co., 101 Park avenue, New York, are engineers.

Millville, N. J.—The Millville Light & Power Co., is planning for the construction of an addition to its power plant at Second and Cypress streets to cost about $500,000, with generating and operating equipment. S. J. Franklin is engineer and manager.

Trenton, N. J.—The Trenton Flint & Spar Co., has plans under way for the erection of a power house at its plant on Marion street.

Abington, Pa.—The board of directors, Abington Memorial Hospital, is considering plans for the erection of a one-story power plant at the institution. Tilden & Register, 1525 Locust street, Philadelphia, are architects.

Lock Haven, Pa.—The Lock Haven Electric Light & Power Co., will proceed at once with the erection of its proposed electric generating plant, estimated to cost about $300,000, including equipment. Henry R. Kent & Co., 5 Erie avenue, Rutherford, N. J., are engineers.

Masontown, Pa.—Fire, Jan. 20, destroyed the power house at the Patrick mine of the Nicholson Coal Co., with loss estimated at about $25,000. It will be rebuilt.

Northampton, Pa.—The Pennsylvania Utilities Co., has filed notice with the Public Service Commission of an advance in power rates in the Bath district, for cement companies and other industrial concerns.

Philadelphia, Pa.—The Barber Asphalt Paving Co., Land Title building, has taken bids for the power plant and auxiliary power building to be constructed at its works at Maurer, N. J. The entire plant, including asphalt working buildings, is estimated to cost $1,000,000.

Philadelphia, Pa.—The bureau of health has awarded a contract to George H. Evans, 45 North 13th street, for the construction of a one-story addition to the power plant at the Philadelphia Hospital for the Insane, Byberry.

Philadelphia, Pa.—The city council and the Fairmount Park commission have signed a contract with the Philadelphia Electric Co., for lighting service during the coming year. The agreement has been submitted to the Public Service Commission for approval.

Philadelphia, Pa.—The United Gas Improvement Co., Broad and Arch streets, has disposed of a note issue of $7,500,000, the proceeds to be used for general operations, extensions, improvements, etc.

Philadelphia, Pa.—The Penn Central Light & Power Co., 611 Chest-

nut street, operating at Altoona, Hollidaysburg, Lewistown, Mt. Union and vicinity, is planning for an increase in its capital stock from 93,140 shares, no par value, to 108,140 shares of stock, no par value.

Pittsburgh, Pa.—The Public Service Commission has approved the purchase of the Smith Power Co., by the Duquesne Light Co.

Pittsburgh, Pa.—The West Penn Power Co., is reported to be planning for a continuance of the water power development work on the Cheat river, West Virginia, inaugurated by the local Kuhn interests in 1916. The work will include the construction of a number of hydroelectric generating plants, and is estimated to cost about $15,000,000 for entire completion. The carrying out of the project is dependent upon necessary state action, and three amendments are before the West Virginia Legislature for proper legislation. The West Virginia Power & Transmission Co., is interested in the work.

Ridgway, Pa.—Following a hearing before the Public Service Commission, permission has been granted for the merger of twelve electric companies operating in Elk county and vicinity into the Keystone Electric Service Co., capitalized at $2,000,000, with headquarters at Ridgway. The companies merged are the Fox township, Benzinger township, Jones township, Hamlin township, James City, Mt. Jewett, Ridgway township and Wetmore township electric companies; the Ridgway Electric Light Co., Johnsonburg Light & Power Co., Kane Electric Light & Power Co., and St. Mary's Electric Light Co. J. George Kaelber, Rochester, Pa., is president of the new company.

Washington, Pa.—The city council has signed a contract with the West Penn Power Co., for the installation and operation of a street-lighting system. The agreement has been submitted to the Public Service Commission for approval.

Baltimore, Md.—The Consolidated Gas, Electric Light & Power Co., is reported to be planning for the erection of its proposed power plant at Dundalk. It is said that ground will be broken in the spring.

Baltimore, Md.—The United Rail ways & Electric Co., Continental building, has arranged for a note issue to total $1,500,000, for general operating and corporate purposes. C. D. Emmons is president.

Frederick, Md.—The Nicodemus Ice Cream Co., is planning for the construction of a one-story power house in connection with a three-story manufacturing plant. H. O. Nicodemus is president.

Providence, Md.—The Jessup & Moore Paper Co., Philadelphia, is planning for extensions and improvements in the one-story plant at its local works.

Petersburg, Va.—The Chesterfield Mfg. Co., is planning to construct an electric power plant to furnish light and power, for the present mill and the larger mill to be built this year. The cost is estimated at $75,000. J. F. Taylor is president.

Radford, Va.—The Norfolk & Western Railroad Co., will soon break ground for the erection of its proposed one-story power station here. The headquarters of the company are at Roanoke, Va.

Charlotte, N. C.—The Southern Power Co., has preliminary plans under way for the erection of a hydroelectric power plant on the Catawba river, with initial capacity of about 35,000-hp. The proposed plant, with transmission system, is estimated to cost in excess of $5,000,000.

Newton, N. C.—The city has plans under way for the installation of an electric light, power and water plant. Bonds in the sum of $14,000 have been issued. The mayor is in charge.

Charleston, S. C.—The Bureau of Yards & Docks, Washington, D. C., has plans under way for extensions and improvements in the power plant at the local naval yards.

Fernadina, Fla.—The city council has plans under way for improvements to the municipal light plant. The mayor is in charge.

Miami, Fla.—The Pompano-by-the-Seas Co., has plans under way for the installation of an electric lighting plant. A. T. Barkdull, 29 North East 2nd avenue, is secretary.

Safety Harbor, Fla.—The town has been ordered to vote on a bond issue of $10,000, for the purpose of purchasing and establishing an electric light plant.

Tampa, Fla.—The Tampa Electric Co., is planning for extensions and improvements in the local street-lighting system, to include new 50 and 100 cp. lighting units.

NORTH CENTRAL STATES.

Springfield, O.—The Springfield Light, Heat & Power Co., is planning to spend $200,000 for improvements during 1921. The proposed plans include construction work, betterment of the distribution system, and the installation of automatic voltage regulators, which will insure steady service. C. I. Weaver is general manager.

Wapakoneta, O.—Bonds in the sum of $110,000 have been voted for the rehabilitation of the electric light plant, including the buying of current.

Evart, Mich.—The village council and board of trade are backing the project of the Winterfield Light Co., of Marion. W. L. Kinney has asked the residents to buy at least $40,000 in bonds to insure the success of the undertaking.

Sunfield, Mich.—The village finds the Consumers Power Co.'s proposition for furnishing electricity for lights and power so expensive, that it is probable there will be no further negotiations with them. A local plant may be installed, for which the council will have specifications drawn up, and the matter of purchasing and installing the plant will go forward as rapidly as possible.

Traverse City, Mich.—An election will be held April 4, to vote on the question of issuing $250,000 in bonds, for the installation of a hydroelectric plant. Mr. Moffatt is city clerk.

Carlinville, Ill.—The Consolidated Coal Co., will erect a power plant, which will cost about $800,000. It will contain four 600-hp. engines, and three turbine engines which will supply the power for the moving of the electric generators.

Pekin, Ill.—The South Pekin village board of trustees, have passed an ordinance granting the South Pekining Light & Power Co. a 25-year franchise to supply heat, light and power to the village and to outside patrons. J. S. Hill is mayor.

Beloit, Wis.—The Beloit Water, Gas & Electric Co., has been granted a franchise by the county board, to extend its line to Turtle township.

Janesville, Wis.—Plans are being prepared for the installation of an ornamental street lighting system, by C. V. Kerch, engineer, City hall. The cost is estimated at $15,000. E. J. Sartell is city clerk.

Milford, Ia.—An election will be held soon to vote on the question of issuing $1700 in bonds, for reconstructing the electric light plant and waterworks. J. E. Shellidy is city clerk.

Sibley, Ia.—The city has plans under way for the installation of a "white way" street lighting system in the business section. R. D. Stewart is village clerk.

St. Louis, Mo.—The United Railways Co., 39th and Park avenue, plans to erect four electric plants for traction service, at an estimated cost of $285,000. W. E. Bryan is superintendent.

Warrensburg, Mo.—The city has plans under way for the installation of a lighting plant. Frank L. Wilcox, St. Louis, is consulting engineer.

Chase, Kan.—The city has taken over the partly constructed 5-mi. power line from the Pawnee Power & Water Co.

Philip, S. D.—Charles H. Holcomb is planning improvements in the electric light and power plant he recently purchased.

SOUTH CENTRAL STATES.

Walton, Ky.—The Reliance Engineering Co., architect and engineer, 809 4th National Bank building, Cincinnati, has prepared plans for the erection of a municipal light plant for the village. The cost is estimated at $13,000. Robert W. Jones is chairman of the commission.

Columbia, Tenn.—The Southern Cities Power Co. has plans under way for the construction of a power line to reach to the plant of the Armour Fertilizer, to furnish service for the works.

Friendship, Tenn.—The Marvel Milling Co. is planning for the rebuilding of its local electric power plant, recently destroyed by fire, operated in connection with its flour mill.

Wales, Tenn.—The International Agricultural Corp. will electrify its plant at a cost estimated in excess of $300,000. The work will include the installation of electric motors and considerable equipment for general

fertilizer production, all electrically operated. To secure service a new three-phase, 6600-volt line will be constructed to a connection about 20 mi. distant, and a transformer station for step-down service will be constructed. J. A. Barr, Mt. Pleasant, Tenn., is engineer for the project.

Bellwood, Ala.—The city will vote on a bond issue of $750,000, for developing a water power site on the Choctawatchie river. The mayor is in charge.

Florence, Ala.—The Bureau of Yards and Docks, Washington, D. C., has awarded a contract to the S. Morgan Smith Co., York, Pa., for turbine equipment for installation at the local power plant.

Lexington, Miss.—The borough council has perfected plans for the installation of a electric street-lighting system.

Pascagoula, Miss.—The city council has called a special election on Feb. 14, to vote on the purchase of the local electric power plant. On acquisition, it is proposed to make extensions and improvements for increased service.

Oklahoma City, Okla.—C. P. Needer and M. Jayne, architects, Empress Theater building, are planning the installation of a 1000-hp. power plant in the proposed American Legion Hospital building.

Roby, Tex.—The Roby Water & Light Co. has been organized and will construct 4½ miles of transmission system, costing about $6500. The plans include the development of 50 hp. and the installation of a 2300-volt a-c., three-phase, 60-cycle switchboard complete. L. C. Eastland, Box 166, is manager and engineer.

San Antonio, Tex. — The Public Service Co. will increase its capital from $4,700,000 to $7,000,000. Additional machinery will be installed, and $250,000 expended on improvements in its power plant.

Ballinger, Tex.—The commission has announced that a municipal power plant will be built.

Coleman, Tex.—The city council is planning for improvements and extensions in its municipal electric plant for increased capacity.

Dallas, Tex.—The Winchester-Texas Oil & Refining Co. will install a generating plant in the Sipe Springs field. William L. McKay is production manager.

Houston, Tex.—The Lucey Mfg. Co., is reported to be arranging for the rebuilding of the power plant at its local oil well machinery works, recently damaged by fire.

WESTERN STATES.

Buena Vista, Cal.—Grace S. Eyre has applied to the Federal Power Commission for license to construct a diversion dam, pipe line, power house and transmission line in Chaffee county, Colorado.

Los Angeles, Cal.—The department of public service, 603 Knickerbocker building, has applied to the Federal Power Commission for license to construct a transmission line in Inyo and Los Angeles counties.

Los Angeles, Cal.—The department of public service, 603 Knickerbocker building, has applied to the Federal Power Commission for a preliminary permit to construct a dam, storage reservoir, conduit and power house, on the South fork of the Kern river, Tulare county.

Los Angeles, Cal.—The department of public service, 603 Knickerbocker building, has applied to the Federal Power Commission for a preliminary permit to construct a dam and storage reservoir, diversion dam, conduits and power houses at Owens river gorge, in Mono and Inyo counties, California.

Los Angeles, Cal.—The department of public service, 603 Knickerbocker building, has made application to the Federal Power Commission for a preliminary permit, to construct a dam and reservoir, conduit and power house on South forks, Kings river.

Oroville, Cal.—The Great Western Power Co. has filed a permit to build a dam, reservoir and conduit 18 mi. long to a power house on the north fork of the Feather river. The cost is estimated at $6,000,000.

INCORPORATIONS.

New York, N. Y.—Special Motor & Machine Co. Capital, $30,000. To manufacture electrical equipment, etc. Incorporators: C. R. Baird, 24 East 23d street; F. F. Baum, J. W. Brautigan and others.

New Haven, Conn.—Weston Battery Co. Capital, $100,000. To manufacture electrical supplies. Incorporators: F. P. Hauser, Ansonia, Conn.; J. H. Benedict, Westport, Conn.; F. L. Barnes, Harry Weston, Jr., and others.

Grantwood, N. J.—R. B. N. Rotary Motors Corp. Capital, $125,000. To manufacture motors and parts. Incorporators: William R. Krebs, P. E. Brulatour, E. W. Norton and others.

Chicago, Ill. — Illuminating Manufacturing Corp. Capital, $25,000. To manufacture lighting fixtures. Incorporators: James R. Hughes, 15 South Clinton street; W. C. Duncan, Jacob Ahren and others.

Wilmington, Del.—Provident Products Corp. Capital, $300,000. To manufacture lighting devices. Incorporators: Charles B. Bishop, A. M. Fox, and R. H. Ochletree.

New York, N. Y.—Brevard Electrical Corp. Capital, $200,000. To manufacture electrical equipment. Incorporators: W. H. Reid, 128 Broadway; P. Brevard, F. L. Reid and others.

Newark, N. J.—Efficient Electric Protection Co. To manufacture electric alarm systems and equipment. Incorporators: Frank Silsen, 86 Jefferson street, and others.

New York, N. Y.—Maples Washing Machine Co. Capital, $1,000,000. To manufacture electrically operated washing machines and parts. Incorporators: L. Maples, 311 Fifth avenue; R. Lasker and D. H. Lehman.

Wilkinsburg, Pa. — Electric Auto Signal Co. Capital, $100,000. To manufacture electrically operated automobile products. Incorporators: C. R. Blakely, Trafford, Pa.; B. Hudson, Wilkinsburg, and A. J. Henseler, Pittsburgh.

Baraboo, Wis.—Baraboo Manufacturing Co. Capital, $100,000. To manufacture electrically operated refrigerating units for domestic and commercial use. Incorporators: Ferdinand Effinger, W. M. Ott, George W. Andrews and others.

Wauwatosa, Wis.—Liberty Machine Co. Capital, $10,000. To manufacture electric-lighting fixtures, etc. Incorporators: Jeremiah Keeler, A. E. Stroud and W. J. Grede.

FOREIGN TRADE.

[Addresses of firms referred to in these trade opportunities may be obtained by writing to the Bureau of Foreign and Domestic Commerce, Washington, D. C., or its branch and local co-operative offices. Request for each opportunity should be on a separate sheet and the file number given.]

Electrical Appliances (34,306)—A wholesale dealer in electro-technical lines in Switzerland wishes to get in touch with electrical lamp-bulb manufacturers with a view to purchasing these products. No reference offered.

Electrical Appliances (34,313)—A merchant in Ireland desires to secure an agency for the sale of electrical appliances. Quotations should be given c. i. f. Irish port. Reference.

Electrical Appliances (34,334)—A New Zealand purchasing agent who is at present in the United States desires to secure agencies for electrical appliances, including electrical household devices, etc. References.

Electrolytic Copper Wire (34,333)—A mercantile firm in Spain desires to secure an agency and purchase on its own account electrolytic copper wire from 1 to 9 mm. Quotations should be given c. i. f. Spanish port. Payment to be made on delivery of merchandise. Correspondence should be in Spanish. References.

Electrical Goods (34,324)—An importing firm in India desires to be placed in touch with manufacturers and exporters for the purchase of electrical goods. References.

Electrical Supplies (34,329)—A consulting engineer in Portugal desires to purchase electrical supplies for a municipal lighting plant and street-railway system. Quotations should be given c. i. f. Lisbon. Correspondence should be in Portuguese. Catalogs are requested.

Magneto Telephones (34,327) — A wholesale merchant in India desires to be placed in touch with a manufacturer of magneto telephones with a view to obtaining the agency for such a line.

Electrical Apparatus, etc. (34,351)—A commercial agent in Spain desires to secure the representation of firms for the advertising and organizing of sales offices for the sale of electric motors, washing machines for home use, electric cooking ranges, etc. References.

Electrical Goods (34,350)—A firm of commission agents in India desires to get in touch with American firms for the importation of electrical goods. Agencies for this line are desired for sale in British India, Burma and Ceylon. Reference.

FINANCIAL NEWS

Comment on the Financial Outlook in the Electrical Industry, New Securities, Reports of Earnings, Dividends and Utility Stocks

Sale of $100,000,000 Foreign Trade Financing Corporation Stock.

The country-wide campaign for the sale of the $100,000,000 capital stock of the Foreign Trade Financing Corp. began Jan. 31. The new corporation, charter of which was approved by the Federal Reserve Board last week, and the presidency of which has been tendered to W. P. G. Harding, governor of the Federal Reserve Board, is the first big step backed by the business men, bankers and producers of the country, to extend long term credits to foreign buyers of American goods, and thus to break the threatened paralysis of our international trade. The prospectus giving the definite plans of the committee on organization has been sent to the 30,000 banks in the country, and will be distributed this week to thousands of manufacturers and producers. It outlines in detail the organization purposes and the method of operation of the new corporation. This prospectus which is the development of two years' study and work by many of the leading business men of the country, outlines the method by which one of the most pressing problems confronting American business will be handled. Through the organization of this corporation, means of extending at least $1,000,000,000 in long term credits to foreign customers of America will be provided. The corporation is designed not only to offer a safe and sound investment, but also to render a great public service to America by providing means for breaking the deadlock in foreign trade.

The committee on organization which is in charge of forming the corporation was appointed by a nation-wide conference of 500 of the leading bankers, business men, and representatives of producing and agricultural interests of the country, held in Chicago last month, which Herbert Hoover termed the "most momentous economic conference in the country since the armistice."

Subscriptions for the stock of the corporation will be received at the rate of $105 a share. There will be no promotion stock or any underwriting commissions, nor will any commission be paid for the sale of stock. A payment of $25 on each share of stock subscribed for will be called in accordance with the provisions of the Edge Act when the corporation is ready to commence business.

Offer of Ohio Power Co. Bonds.

Lee, Higginson & Co., Dillon, Read & Co., and Continental & Commercial Trust & Savings Bank, Chicago, are offering an issue of $10,000,000 Ohio Power Co. first and refunding mortgage series "A" sinking fund gold bonds, dated Jan. 3, 1921, and due Jan. 1, 1951, at 95.25 and interest, to yield about 7.40%. The company owns and operates large electric light and power generating and distributing systems in important manufacturing sections of Ohio, with over 1,152-mi. of transmission and distributing lines, and serving the cities of Canton, Newark, Riffin, Steubenville and the Ohio river district near Wheeling, W. Va., and over 45 cities and towns in the state. The company's main power station is at Windsor, on the Ohio river, near Wheeling. This is one of the largest steam generating turbine plants in the United States, and has its own coal mines adjacent to the plant.

In the last two years to Dec. 31, gross earnings and net income after taxes, maintenance and depreciation charges have been as follows:

	1920.	1919.
Gross earnings	$7,695,842	$5,496,765
Net income	2,477,466	1,920,694

New Issue of Wisconsin-Minnesota Light & Power Co. Notes.

Paine, Webber & Co., Chicago, is offering a new issue of $1,000,000 Wisconsin-Minnesota Light & Power Co. one-year 8% gold notes, dated Feb. 1, 1921, and due Feb. 1, 1922, at 99 to yield over 9.05%.

The Wisconsin-Minnesota Light & Power Co. does a general public utility business, without competition, serving forty-eight communities in western Wisconsin and eastern Minnesota including the cities of La Crosse, Eau Claire, Chippewa Falls, Red Wing and Winona. The proceeds of these notes will be used to retire $600,000 7% notes maturing Feb. 1, 1921, and to meet the financial requirements of the company until more favorable conditions exist for the marketing of its permanent securities.

Appalachian Power Co.

The earnings of the Appalachian Power Co. for the eleven months ended Nov. 30, 1920, were $2,051,812, an increase of 40% over the corresponding eleven months of 1919. The net earnings for the period were $912,926, an increase of 24% over the corresponding previous period. Electric energy output was 133,548,322 kw-hrs., compared with 112,276,211 kw-hrs. for the first eleven months of 1919, or an increase of 19%. The earnings statement is as follows:

Twelve months ended Nov. 30—	1920.	1919.
Gross earnings	$2,051,812	$1,456,174
Net earnings	912,926	735,755

Idaho Power Co.

	1920.	1919.
November gross	$ 181,607	$ 149,629
Net after taxes	79,281	71,640
Total income	91,667	79,749
Surplus after charges	39,162	39,940
Twelve months' gross	2,282,153	1,777,832
Net after taxes	1,179,865	868,072
Total income	1,283,736	929,222
Surplus after charges	762,215	469,907
Balance after preferred dividends	678,459	408,687

Keokuk Electric Co.

	1920.	1919.
December gross earnings	$ 31,803	$ 30,097
Net earnings	6,504	4,385
Surplus after charges	2,924	1,979
For calendar year—		
Gross earnings	356,842	317,237
Net earnings	83,383	53,381
Surplus after charges	52,466	25,513

Binghampton Light, Heat & Power Co.

	1920.	1919.
November operating revenues	$80,285.04	$50,422.53
Operating expenses and taxes	55,947.63	32,333.20
Operating income	$24,337.41	$18,089.33
Amount of maintenance expenditures included in above operating expenses	$ 5,561.96	$ 3,666.26

New Jersey Power & Light Co.

	1920.	1919.
November operating revenues	$45,716.42	$34,314.06
Operating expenses, taxes and rentals	31,195.23	22,219.03
Operating income	$14,521.19	$12,095.03
Amount of maintenance expenditures included in above operating expenses	$ 5,554.33	$ 3,200.60

General Gas & Electric Co.

	1920.	1919.
November operating revenues	$1,076,693.76	$ 843,926.95
Operating expenses, taxes and rentals	836,928.98	596.396.89
Operating income	$ 239,764.78	$ 247,530.06
Amount of maintenance expenditures included in above operating expenses	$ 145,287.42	$ 118,115.86

Twelve months ended Nov. 30,	1920.	1919.
Operating revenues	$11,167,969.67	$8,997,567.21
Operating expenses, taxes and rentals	8,792,714.22	6,351,189.33
Operating income	$2,375,255.45	$2,646,377.88
Amount of maintenance expenditures included in above operating expenses	$1,711,557.15	$1,166,307.12

WEEKLY COMPARISON OF CLOSING-BID PRICES OF SECURITIES OF LEADING ELECTRICAL COMPANIES.

Quotations furnished by F. M. Zeller & Co., Rookery Bldg., Chicago.

	Div. rate, Per cent.	Bid Jan. 25.	Bid Feb. 1.
Public Utilities.			
Adirondack Electric Power of Glens Falls, common	6	14	13
Adirondack Electric Power of Glens Falls, preferred	6	72	71
American Gas & Electric of New York, common	..	95	100
American Gas & Electric of New York, preferred	6	36	37
American Light & Traction of New York, common	..	82	85
American Light & Traction of New York, preferred	6	75	75
American Power & Light of New York, common	4	42	45
American Power & Light of New York, preferred	6	61	65
American Public Utilities of Grand Rapids, common	..	9	10
American Public Utilities of Grand Rapids, preferred	7	19	18
American Telephone & Telegraph of New York	..	103	99
American Water Works & Elec. of New York, common	..	2	2
American Water Works & Elec. of New York, particip	7	4½	4
American Water Works & Elec. of New York 1st preferred	..	40	39
Appalachian Power, common	..	3	3
Appalachian Power, preferred	7	18	20
Cities Service of New York, common	+extra	257	255
Cities Service of New York, preferred	6	65	67
Commonwealth Edison of Chicago	8	104	106
Comm. Power, Railway & Light of Jackson, common	..	14	14
Comm. Power, Railway & Light of Jackson, preferred	6	35	35
Federal Light & Traction of New York, common	..	6½	5
Federal Light & Traction of New York, preferred	..	43	43
Northern States Power of Chicago, common	..	41	43
Northern States Power of Chicago, preferred	ex.div.	7	79	79
Pacific Gas & Electric of San Francisco, common	..	47	48
Public Service of Northern Illinois, Chicago, common	7	57	76
Public Service of Northern Illinois, Chicago, preferred	6	73	80
Standard Gas & Electric of Chicago, common	..	12	12
Standard Gas & Electric of Chicago, preferred	8	34	35
Tennessee Railway, Light & Power of Chattanooga, common	..	1	1
Tennessee Railway, Light & Power of Chattanooga, preferred	6	4	4
Western Power of San Francisco, common	..	21	21
Western Union Telegraph of New York	extra	81	81
Industrials—			
Electric Storage Battery of Philadelphia, common	4	99	98
General Electric of Schenectady	8	112	127
Westinghouse Electric & Mfg. of Pittsburgh, common	7	43	45